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ABSTRACT

This curriculum guide provides materials for a 12-unit secondary course in welding. Purpose stated for the flexible entry and exit course is to help students master manipulative skills to develop successful welding techniques and to gain an understanding of the specialized tools and equipment used in the welding field. Units cover oxyacetylene welding and cutting; shielded arc welding; gas tungsten-arc welding; gas metal-arc welding; flux-cored arc welding; welding shop general equipment and tools; special welding and cutting processes; inspecting, testing welds, procedures, and welder qualifications; production of metals, metal properties, and identification; blueprint reading skills and tasks; applied mathematics; and supervision, training, and estimating. Materials include a course outline with analysis of all tasks to be learned, statement of course philosophy, list of course objectives, listing of personal-social traits essential for the skilled welder, course description, and Dictionary of Occupational Title (DOT) information, including a list of entry-level jobs in welding, a list of possible jobs with additional training, and job descriptions. Over one-half of the guide consists of instructional task identification for welding in a chart format that correlates welding tasks with 10 DOT job classifications in the welding cluster. (YLB)

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The curriculum described in this brochure is the result of a cooperative effort involving the teachers of the Lehigh County Vocatioinal-Technical School and their Craft Advisory members. The curriculum contains those learning experiences that will provide students with skills and knowledge needed both for entry and advancement in their chosen career field. In many cases, the program also provides learning experiences designed to enable students to enter parallel post-seconary educational programs. Advanced standing and credit may be awarded in many cases.

The program consists of learning experiences designed to meet the needs of students who possess a wide range of ability and interest levels. Students are evaluated against competency standards that are predefined and related to standards for entry level jobs.

The program content has been approved by local employers who serve in an advisory capacity. Due to constant technological change, the program undergoes constant review and changes are made when needed.

The material presented in this brochure is an accurate reflection of the philosophy and scope of the program shown below.

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WELDING

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CE 034 000

LEHIGH COUNTY AREA VOCATIONAL TECHNICAL SCHOOL

WELDING

COURSE OUTLINE

1.0 OXYACETYLENE WELDING AND CUTTING PROCESS

2.0 SHIELDED METAL ARC WELDING (SMAW)

3.0 GAS TUNGSTEN-ARC WELDING (GTAW) (TIG)

4.0 GAS METAL-ARC WELDING (GMAW) (MIG)

5.0 FLUX-CORED ARC WELDING (FCAW)

6.0 WELDING SHOP GENERAL EQUIPMENT AND TOOLS

7.0 SPECIAL WELDING AND CUTTING PROCESSES

8.0 INSPECTING, TESTING WELDS, PROCEDRUES, AND WELDER QUALIFICATIONS

9.0 PRODUCTION OR METALS, METAL PROPERTIES AND IDENTIFICATION

10.0 UNDERSTAND AND PERFORM BLUEPRINT READING SKILLS AND TASKS FOR WELDERS

11.0 APPLY THE PRINCIPLES OF PRACTICAL PROBLEMS IN MATHAMATICS RELATED TO THE WORK OF A WELDER

12.0 SUPERVISION, TRAINING, AND ESTIMATING

LEHIGH COUNTY AREA VOCATIONAL TECHNICAL SCHOOL

WELDING

Analysis

1.0 OXYACETYLENE WELDING AND CUTTING PROCESS

1.1 Analyze principles of orientation

1.2 Identify and comply with safety precautions

1.3 Understand & compare oxyacetylene equipment & accessories

1.4 Set up and operate oxyacetylene equipment

1.5 Make welds in the flat position

1.6 Make welds in the horizontal position

1.7 Make welds in the vertical position

1.8 Make welds in the overhead position

1.9 Perform pipe welds

1.10 Understand and perform oxyacetylene brazing operations

1.11 Understand and apply the silver brazing (silver-soldering) process and soft soldering process

1.12 Understand oxyfuel cutting (includes, oxyacetylene cutting) (OFC) (CAC)

2.0. SHIELDED METAL ARC WELDING (SMAW)

2.1 Understand the principles of the shielded metal ARC welding process

2.2 Identify safety hazards & comply with safety precautions

2.3 Understand fundamentals of ARC welding

2.4 Identify types of welding machines, accessories, and supplies

2.5 Understand the A.W.S. Electrode Identification and Classification System

2.6 Weld in the "Flat Position" (downhand welding) using electrode types

2.7 Weld in the "Horizontal Position" using electrode types

2.8 Weld in the "Vertical-up Position" using electrode types

2.9 Weld in the "Overhead Position" using electrode types

2.10 Understand fundamentals of pipe welding

2.11 Understand fundamentals for welding sheet metal (1/8" thickness & less)

2.12 Understand fundamentals of welding cast iron

2.13 Understand fundamentals of welding stainless steel

2.14 Understand fundamentals of hardsurfacing

2.15 Understand fundamentals of cutting with the electric ARC

2.16 Understand fundamentals of ARC-AIR cutting

3.0 GAS TUNGSTEN-ARC WELDING (GTAW) (TIG)

3.1 Understand the principles of operation of the GTAW process

3.2 Identify safety hazards and comply with safety precautions

3.3 Identify types of welding machines, accessories, and supplies used for the GTAW process

3.4 Understand fundamentals for TIG welding aluminum

3.5 Make welds on aluminum in the flat position

3.6 Make welds on Aluminum in the Horizontal Position

3.7 Make welds on Aluminum in the Vertical Position

3.8 Make welds on Aluminum in the Overhead Position

3.9 Make welds on Aluminum pipe

3.10 Understand fundamentals of welding stainless steels and mild carbon steel

3.11 Make welds in the flat position

3.12 Make welds in the horizontal position

3.13 Make welds in the vertical position

3.14 Make welds in the overhead position

4.0 GAS METAL-ARC WELDING (GMAW) (MIG)

4.1 Understand the principles of operation of the GMAW process

4.2 Identify safety hazards and comply with safety precautions

4.3 Identify types of welding machines, accessories, and supplies used for the GMAW process

4.4 Set up and adjust GMAW equipment

4.5 Make welds on Mild steel in the Flat position

4.6 Make welds on Mild steel in the Horizontal position

4.7 Make welds on Mild steel in the Vertical position

4.8 Make welds on Mild steel in the Overhead position

4.9 Make welds on mild steel pipe

4.10 Make welds on Aluminum in the Flat position

4.11 Make welds on Aluminum in the Horizontal position

4.12 Make welds on Aluminum in the Vertical position

4.13 Make welds on Aluminum in the Overhead position

4.14 Make welds on Aluminum pipe

5.0 FLUX-CORED ARC WELDING (FCAW)

5.1 Understand the principles of operation of the FCAW process

5.2 Identify safety hazards and comply with safety precautions

5.3 Identify types of welding machines, accessories, and supplies used for the FCAW process

5.4 Set up and adjust FCAW equipment

5.5 Make welds on Mild steel in the Flat position

5.6 Make welds on Mild steel in the Horizontal position

5.7 Make welds on Mild steel in the Vertical position

6.0 WELDING SHOP GENERAL EQUIPMENT AND TOOLS

6.1 Identify and use hand tools

6.2 Identify, and use power tools and power equipment, in a safe manner

6.3 Perform periodic maintenance and make repairs on welding and cutting equipment

6.4 Inspect work area for safe working enviornment

7.0 SPECIAL WELDING AND CUTTING PROCESSES

7.1 Study and describe special welding processes

7.2 Study and describe special cutting processes

8.0 INSPECTING, TESTING WELDS, PROCEDRUES, AND WELDER QUALIFICATIONS

8.1 Understand the types of Non-Destructive Tests and classify the methods of testing

8.2 Understand the types of Destructive Tests and classify the methods of testing

8.3 Describe and define welder qualification and welding procedures

9.0 PRODUCTION OR METALS, METAL PROPERTIES AND IDENTIFICATION

9.1 Study the methods of manufacturing steel

9.2 Study the manufacturing of stainless steels

9.3 Study the manufacturing of copper

9.4 Study the manufacturing of brass and bronze

9.5 Study the manufacturing of aluminum

9.6 Study the processing of metals

9.7 Study metal properties and identification of ferrous metals

9.8 Study metal properties and identification of non ferrous metals

9.9 Study the heat treatment of metals

10.0 UNDERSTAND AND PERFORM BLUEPRINT READING SKILLS AND TASKS FOR WELDERS

10.1 Interpret and draw basic lines

10.2 Interpret and draw basic views

10.3 Interpret and recognize notes and specifications

10.4 Calculate, identify, and write dimensions

10.5 Interpret and identify structural shapes

10.6 Interpret and identify other views

10.7 Interpret and identify sections

10.8 Interpret and identify detail and assemble prints

10.9 Identify and recognize general abbreviations and symbols

10.10 Understand components of the welding symbol

10.11 Understand and recognize welding abbreviations

10.12 Identify, interpret and draw the fillet weld symbol

10.13 Identify, interpret and draw the groove weld symbol

10.14 Identify, interpret and draw the back or backing and melt-thru symbols

10.15 Identify, interpret and draw the plug and slot weld symbols

10.16 Identify, interpret and draw the surfacing weld and flash or upset weld symbols

10.17 Identify, interpret and draw the flange weld symbol

10.18 Identify, interpret and draw the spot weld symbol

10.19 Identify, interpret and draw the projection weld symbol

10.20 Identify, interpret and draw the seam weld and non-preferred welding symbols

11.0 APPLY THE PRINCIPLES OF PRACTICAL PROBLEMS IN MATHAMATICS RELATED TO THE WORK OF A WELDER

11.1 Compute whole numbers

11.2 Compute common fractions

11.3 Compute decimal fractions

11.4 Compute linear measure

11.5 Compute angular measures

11.6 Compute surface measurement

11.7 Compute volume measure, capacity, and weight

11.8 Compute averages and percents

11.9 Compute pieces and lengths

11.10 Compute wages and salary

12.0 SUPERVISION, TRAINING, AND ESTIMATING

12.1 Perform supervisory functions, conduct training sessions and make estimates

LEHIGH COUNTY AREA VOCATIONAL TECHNICAL SCHOOL

WELDING

Instructional Units

1.0 OXYACETYLENE WELDING AND CUTTING PROCESS

1.1 Analyze principles of orientation

1.1.1 Recognize & apply principles of oxyacetylene welding

1.1.2 Recognize & apply principles of oxyacetylene cutting

1.1.3 Recognize & apply other fuel-gas welding and cutting processes

1.2 Identify and comply with safety precautions

1.2.1 Identify and comply with general safety precautions for welding (OSHA regulations)

1.2.2 Use personnel safety equipment and clothing

1.2.3 Establish safe working habits & report safety hazards

1.3 Understand & compare oxyacetylene equipment & accessories

1.3.1 Identify oxygen and acetylene cylinders and mfg. of gases

1.3.2 Identify & compare regulators

1.3.3 Identify hoses

1.3.4 Identify & compare types of torches

1.3.5 Identify & compare welding tips

1.3.6 Identify & compare cutting tips

1.3.7 Identify & compare cutting torches

1.3.8 Identify cutting machines

1.3.9 Identify an oxygen and acetylene manifold system

1.4 Set up and operate oxyacetylene equipment

1.4.1 Set up and assemble a portable oxyacetylene welding & cutting outfit and stationary manifold system.

1.4.1.1 Clean a dirty or clogged welding tip.

1.4.2 Safely store and use oxygen, acetylene and compressed gas cylinders

1.4.2.1 Change an empty compressed gas cylinder

1.4.3 Turn on the gases, adjust the pressure settings, and shut down a typical oxyacetylene outfit

1.4.4 Safely light the oxy-fuel torch, adjust to various types of flames, and extinguish the torch.

1.4.5 Identify welding positions

1.4.6 Identify and select types of welds and types of joints

1.4.7 Identify and prevent problems of distortion

1.4.8 Identify and select filler materials

1.5 Make welds in the flat position

1.5.1 Make welds in the flat position (1/8" thickness and thinner)

1.5.2 Make welds on heavy plate (3/16" thickness and heavier)

1.5.3 Make weld beads with no filler rod (puddling)

1.5.4 Make weld beads using a filler rod

1.5.5 Tack weld various joints (butt, lap, tee, edge, corner)

1.5.6 Identify variables affecting weld bead quality

1.5.7 Weld an edge joint using no filler rod

1.5.8 Weld a corner joint

1.5.9 Weld a tee joint making a fillet weld

1.5.10 Weld a square groove butt joint

1.5.11 Weld a lap joint

1.5.12 Weld a single V-butt joint on heavy plate

1.6 Make welds in the horizontal position

1.6.1 Make horizontal weld beads on a vertical surface

1.6.2 Weld a horizontal-square groove butt joint

1.6.3 Weld a horizontal-lap joint

1.6.4 Weld a horizontal tee joint with a single pass fillet weld

1.6.5 Weld a horizontal-single V-butt weld on 1/4" plate or heavier

1.7 Make welds in the vertical position

1.7.1 Make vertical-up weld beads on a vertical surface (uphill technique)

1.7.2 Weld a vertical-square groove butt weld

1.7.3 Weld a vertical-lap joint

1.7.4 Weld a vertical tee joint with a single pass fillet weld

1.7.5 Weld a vertical-corner joint

1.7.6 Weld a vertical-single V-groove butt weld on 1/4" plate or heavier

1.8 Make welds in the overhead position

1.8.1 Make overhead stringer beads

1.8.2 Weld an over head square-groove butt joint

1.8.3 Weld an over head lap joint

1.8.4 Weld an overhead tee joint with a single-pass fillet weld

1.8.5 Weld an overhead-single V-groove butt weld on 1/4" plate or heavier

1.9 Perform pipe welds

1.9.1 Identify pipe weld positions
Rolling position (1G)
Horizontal fixed (5G)
Vertical tube (2G)
Inclined position (6G)

1.9.2 Deposit weld beads on pipe in various positions (1G)-(5G)-(2G)-(6G)

1.9.3 Weld a pipe joint in the rolled position (1G)

1.9.4 Weld a pipe joint in the horizontal fixed position (5G)

1.9.5 Weld a pipe joint in the vertical tube position (2G)

1.9.6 Weld a pipe joint in the inclined position (6G)

1.10 Understand and perform oxyacetylene brazing operations

1.10.1 Understand principles of brazing

1.10.2 Recognize the use of flux

1.10.3 Select filler materials

1.10.4 Identify joint designs (butt, lap, tee, edge, corner)

1.10.5 Select and set-up equipment for brazing operations

1.10.6 Make braze welds in the flat position

1.10.6.1 Make braze weld beads

1.10.6.2 Braze a square grooved butt joint

1.10.6.3 Braze a lap joint

1.10.6.4 Braze a tee joint

1.10.6.5 Braze a single-Vee butt joint on heavy plate

1.10.7 Make braze welds in the horizontal position

1.10.7.1 Make horizontal braze weld beads on a vertical surface

1.10.7.2 Braze a square grooved butt joint

1.10.7.3 Braze a lap joint

1.10.7.4 Braze a tee joint

1.10.7.5 Braze a single-Vee butt joint on heavy plate

1.10.8 Make braze welds in the vertical-up position

1.10.8.1 Make vertical braze weld beads (vertical-up technique)

1.10.8.2 Braze a square grooved butt joint

1.10.8.3 Braze a lap joint

1.10.8.4 Braze a tee joint

1.10.8.5 Braze a single-Vee butt joint on heavy plate

1.10.9 Make braze welds in the overhead position

1.10.9.1 Deposit overhead braze weld beads

1.10.9.2 Braze a square-grooved butt joint

1.10.9.3 Braze a lap joint

1.10.9.4 Braze a tee joint

1.10.9.5 Braze a single-Vee butt joint on heavy plate

1.11 Understand and apply the silver brazing (silver-soldering) process and soft soldering process

1.11.1 Understand the fundamentals of silver brazing

1.11.2 Identify joint designs and joint fit-up for silver

brazing and soft soldering

1.11.3 Identify filler alloys and fluxes for silver brazing and soft soldering

1.11.4 Silver solder a lap joint on ferrous and nonferrous metals

1.11.5 Silver solder a tee joint on ferrous and nonferrous metals

1.11.6 Silver solder a copper tubing joint

1.11.7 Understand the fundamentals of soft soldering

1.11.8 Soft solder a lap joint on ferrous and nonferrous metals

1.11.9 Soft solder a tee joint on ferrous and nonferrous metals

1.11.10 Soft solder a copper tubing joint

1.12 Understand oxyfuel cutting (includes, oxyacetylene cutting) (OFC) (OAC)

1.12.1 Analyze principles of oxyfuel cutting

1.12.2 Recognize and observe safety precautions when oxyfuel cutting

1.12.3 Perform straight line cutting operations on mild steel

1.12.4 Perform bevel cuts on heavy plates

1.12.5 Pierce holes and cut circles

1.12.6 Perform gouging and scarfing operations

1.12.6.1 Remove a weld by gouging

1.12.6.2 Remove a backing strip from a test plate by scarfing

1.12.7 Set up a cutting machine (radiagraph) and make straight-line cuts and bevel cuts

1.12.8 Set up a manual pipe cutting machine and make bevel cuts on pipe

1.12.9 Clean a dirty or clogged cutting tip

1.12.10 Change a cutting tip on an oxyfuel cutting torch

2.0 SHIELDED METAL ARC WELDING (SMAW)

2.1 Understand the principles of the shielded metal ARC welding process

2.1.1 Recognize basic electrical principles

2.1.2 Analyze the ARC welding process

2.1.3 Name the types of welding current and describe polarity

2.1.4 Describe "ARC BLOW" and know the remedies

2.1.5 Analyze the effects of welding heat on metals

2.1.6 Name & define trade terms & definitions used in the welding trade

2.1.7 Study and compare the "master chart of welding processes"

2.2 Identify safety hazards & comply with safety precautions

2.2.1 Identify general safety rules for ARC welding

2.2.2 Use protective clothing, personal equipment, and proper eye protection

2.2.3 Wear and maintain a welding helmet in compliance with prescribed safety standards

2.3 Understand fundamentals of ARC welding

2.3.1 Set up a welding station in preparation for welding

2.3.2 Demonstrate methods of striking the ARC

2.3.3 Identify types of welds and types of joints for ARC welding

2.3.4 Identify types of beads

2.3.5 Identify welding positions

2.4 Identify types of welding machines, accessories, and supplies

2.4.1 Identify direct current (D.C.) welding machines and set up a typical A.C. welding machine

2.4.2 Identify alternating current (A.C.) welding machines and set up a typical A.C. welding machine

2.4.3 Set up & operate engine driven generators

2.4.4 Identify accessories used for arc welding

2.4.5 Repair and maintain arc welding equipment & accessories

2.4.6 Order welding supplies and materials required for daily operation of a welding shop

2.5 Understand the A.W.S. Electrode Identification and Classification System

2.5.1 Identify and classify electrodes used to weld mild steel

2.5.2 Identify and classify electrodes used to weld cast iron

2.5.3 Identify and classify electrodes used to weld stainless steel

2.5.4 Identify and classify electrodes used to do hardsurfacing operations

2.5.5 Identify and classify electrodes used to weld nonferrous materials

2.6 Weld in the "Flat Position" (Downhand welding) using electrode types

E6010	E7014
E6011	E7018
E6012	E7024
E6013	E7028
E6020	

With electrodes ranging from 5/64" to 1/4" in diameter

2.6.1 Strike an arc and run short stringer beads

2.6.1.1 Clean a weld bead using a chipping hammer and wire brush

2.6.2 Restart an arc, and make a continuous weld bead and fill the crater

2.6.3 Make weld beads using the "weaving" motion

2.6.4 Make weld beads using the "whipping" motion with E6010 and E6011 type electrodes

2.6.5 Build a weld metal pad (padding)

2.6.6 Recognize and analyze variables affecting the quality of weld beads. Determine proper amperage setting, arc length, angle of electrode, & speed of travel

2.6.7 Weld a square-grooved butt joint

2.6.8 Weld a lap joint with a single-pass fillet weld
2.6.8.1 Weld a lap joint with a multiple-pass fillet weld
2.6.9 Weld a tee joint with a single-pass fillet weld
2.6.9.1 Weld a tee joint with a multiple-pass fillet weld

2.6.10 Weld an open corner joint

2.6.11 Weld a single-vee butt joint with a backing strip

2.6.12 Weld a single-vee butt joint (groove weld) without a backing strip

2.6.13 Set up, weld, and test a groove weld test plate in accordance with AWS standards (1G)

2.6.14 Set up, weld, and test a fillet weld test plate in accordance with AWS standards (1F)

2.7 Weld in the "HORIZONTAL POSITION" using electrode types:

E6010	E7014
E6011	E7024
E6012	E7018
E6013	E7028

2.7.1 Make weld beads in the horizontal position
2.7,1.1 Run "STRINGER" beads
2.7.1.2 Run "WHIP" beads
2.7.1.3 Run "WEAVE" beads

2.7.2 Weld a square-grooved butt joint

2.7.3 Weld a lap joint with a single-pass fillet weld

2.7.3.1 Weld a lap joint with a multiple-pass fillet weld

2.7.4 Weld a tee joint with a single-pass fillet weld

2.7.4.1 Weld a tee joint with a multiple-pass fillet weld

2.7.5 Weld a single-vee butt joint (groove weld) with a backing strip

2.7.6 Weld a single-vee butt joint (groove weld) without a backing strip

2.7.7 Set up, weld, and test a groove weld test plate in accordance with AWS standards (2G)

2.7.8 Set up, weld, and test a fillet weld test plate in accordance with AWS standards (2F)

2.8 Weld in the "VERTICAL-UP POSITION" using electrode types:

E6010	E7014
E6011	
E6012	E7018
E6013	

2.8.1 Make weld beads in the vertical-up position

2.7.1.1 Run "STRINGER" beads
2.7.1.2 Run "WHIP" beads
2.7.1.3 Run "WEAVE" beads

2.8.2 Weld a square-grooved butt joint

2.8.3 Weld a lap joint with a single-pass fillet weld
2.7.3.1 Weld a lap joint with a multiple-pass fillet weld

2.8.4 Weld a tee joint with a single-pass fillet weld
2.7.4.1 Weld a tee joint with a multiple-pass fillet weld

2.8.5 Weld a single-vee butt joint (groove weld) with a backing strip

2.8.6 Weld a single-vee butt joint (groove weld) without a backing strip

2.8.7 Set up, weld, and test a groove weld test plate in accordance with AWS standards (3G)

2.8.8 Set up, weld, and test a fillet weld test plate in accordance with AWS standards (3F)

2.9 Weld in the "OVERHEAD POSITION" using electrode types:
E6010
E6011
E6012
E6013
E7018

2.9.1 Make weld beads in the overhead position
2.7.1.1 Run "STRINGER" beads
2.7.1.2 Run "WHIP" beads
2.7.1.3 Run "WEAVE" beads

2.9.2 Weld a square-grooved butt joint

2.9.3 Weld a lap joint with a single-pass fillet weld
2.7.3.1 Weld a lap joint with a multiple-pass fillet weld

2.9.4 Weld a tee joint with a single-pass fillet weld
2.7.4.1 Weld a tee joint with a multiple-pass fillet weld

2.9.5 Weld a single-vee butt joint (groove weld) with a backing strip

2.9.6 Weld a single-vee butt joint (groove weld) without a backing strip

2.9.7 Set up, weld, and test a groove weld test plate in accordance with AWS standards (4G)

2.9.8 Set up, weld, and test a fillet weld test plate in accordance with AWS standards (4F)

2.10 UNDERSTAND FUNDAMENTALS OF PIPE WELDING

2.10.1 Know principles for welding transmission line pipe welding

2.10.2 Know principles for welding industrial pipe welding -

2.10.3 Make weld beads on pipe using electrode types:

E6010	E7010
E6011	E7018

2.10.3.1. Weld a pipe joint in the rolled (1G) position

2.10.3.2 Weld a pipe joint in the vertical tube (2G)

2.10.3.3 Weld a pipe joint in the horizontal-fixed (3G) position

2.10.3.4 Weld a pipe joint in the 45 degree inclined (6G) position

2.10.3.5 Set up, weld, and test a welded pipe joint in accordance with AWS standards

2.11 UNDERSTAND FUNDAMENTALS FOR WELDING SHEET METAL (1/8" thickness & less)

2.11.1 Follow recommended specifications for set up procedures

2.11.2 Determine proper joint fit-up for welding practices

2.11.3 Know and demonstrate the use & application of back-up bars

2.11.4 Determine amperage settings and make weld beads on sheet metal

2.11.5 Make welds on sheet metal joints

2.11.5.1 Weld a butt joint

2.11.5.2 Weld a lap joint

2.11.5.3 Weld a tee joint

2.12 UNDERSTAND FUNDAMENTALS OF WELDING CAST IRON

2.12.1 Identify types of cast iron

2.12.2 Prepare a broken casting for welding

2.12.3 Identify and select electrodes for welding cast iron

2.12.4 Weld, repair a broken casting

2.13 UNDERSTAND FUNDAMENTALS OF WELDING STAINLESS STEEL

2.13.1 Identify and categorize types of stainless steels

2.13.2 Identify and select electrodes for welding stainless steels

2.13.3 Clean and prepare stainless steel for welding

2.13.4 Make welds on stainless steel

2.13.4.1 Weld a butt joint

2.13.4.2 Weld a lap joint

2.13.4.3 Weld a tee joint

2.14 UNDERSTAND FUNDAMENTALS OF HARDSURFACING

2.14.1 Analyze service requirements and service conditions for hardfacing

2.14.2 Determine the composition and condition of the part to be hard faced

2.14.3 Follow recommended welding procedures

2.14.4 Identify and select hardsurfacing electrodes

2.14.5 Build up a surface using hardsurfacing electrodes

2.15 UNDERSTAND FUNDAMENTALS OF CUTTING WITH THE ELECTRIC ARC

2.15.1 Know & demonstrate recommended equipment set-up procedures

2.15.2 Identify safety hazards & comply with safety precautions

2.15.3 Make straight line cuts using a shielded metal-arc electrode

2.15.4 Pierce holes in steel plate using a shielded metal-arc electrode

2.16 UNDERSTAND FUNDAMENTALS OF ARC-AIR CUTTING

2.16.1 Know & demonstrate recommended equipment set-up procedures for arc-air cutting

2.16.2 Identify safety hazards & comply with safety precautions

2.16.3 Set up the ARC-air cutting torch, welding machine, and compressed air line

2.16.4 Make gouges in steel plate using the ARC-AIR torch

2.16.5 Cut nonferrous metals using the ARC-AIR torch

2.16.6 Remove a weld by gouging using an ARC-AIR torch

3.0 GAS TUNGSTEN-ARC WELDING (GTAW) (TIG)

3.1 Understand the principles of operation of the GTAW process

3.1.1 Understand & determine the application of TIG welding

3.2 Identify safety hazards and comply with safety precautions

3.2.1 Identify general safety rules for TIG welding

3.2.2 Use protective clothing, personal equipment, and proper eye protection

3.2.3 Wear and maintain a welding helmet in compliance with prescribed safety standards.

3.3 Identify types of welding machines, accessories, and supplies used for the GTAW process

3.3.1 Identify and set up air-cooled and water-cooled TIG torches, cables, and components

3.3.2 Identify and set up regulators, inert gas hoses and adjust flometers

3.3.3 Identify and set up power sources (welding machines) used for the GTAW process

3.3.4 Identify and select filler metals

3.3.5 Identify and select proper shielding gases

3.3.6 Identify and classify types of tungsten electrodes in accordance with AWS standards

3.4 Understand fundamentals for TIG welding aluminum

3.4.1 Recognize and compare the characteristics of welding aluminum

3.4.2 Identify and name the various aluminum alloys

3.4.3 Clean and prepare the characteristics of welding aluminum

3.4.4 Recognize and analyze variables affecting the quality of welds made on aluminum

3.4.5 Change an empty shielding gas cylinder

3.4.6 Know and demonstrate the use and application of back-up bars

3.5 MAKE WELDS ON ALUMINUM IN THE FLAT POSITION

3.5.1 Set up and adjust a welding machine and accessories in preparation for welding aluminum

3.5.2 Establish an arc and run weld beads on aluminum; with and without a remote foot control; with and without the use of filler metal

3.5.3 Make "STRINGER BEADS" using the "DIP" and "DRAG" technique

3.5.4 Weld a square-grooved butt joint

3.5.5 Weld a lap joint making a fillet weld

3.5.6 Weld a tee joint making a single-pass fillet weld

3.5.7 Weld a tee joint making a multiple-pass fillet weld

3.5.8 Weld an open corner joint

3.5.9 Weld an edge joint

3.5.10 Weld a single-vee butt joint with a back-up strip

3.5.11 Weld a single-vee butt joint without a back-up strip

3.6 Make Welds on ALUMINUM in the HORIZONTAL POSITION

3.6.1 Make "STRINGER BEADS" and "WEAVE BEADS" in the Horizontal position

3.6.2 Weld a square-grooved butt joint

3.6.3 Weld a lap joint making a fellet weld

3.6.4 Weld a tee joint making a single-pass fillet weld

3.6.5 Weld a tee joint making a multiple-pass fillet weld

3.6.6 Weld an open corner joint

3.6.7 Weld an edge joint

3.6.8 Weld a single-vee butt joint with a back-up strip

3.6.9 Weld a single-vee butt joint without a back-up strip

3.7 Make Welds on ALUMINUM in the VERTICAL POSITION

3.7.1 Make "STRINGER BEADS" and "WEAVE BEADS" in the vertical-up position

3.7.2 Weld a square-grooved butt joint

3.7.3 Weld a lap joint making a fillet weld

3.7.4 Weld a tee joint making a single-pass fillet weld

3.7.5 Weld a tee joint making a multiple-pass fillet weld

3.7.6 Weld an open corner joint

3.7.7 Weld an edge joint

3.7.8 Weld a single-vee butt joint with a back-up strip

3.7.9 Weld a single-vee butt joint without a back-ip strip

3.8 Make Welds on ALUMINUM in the OVERHEAD POSITION

3.8.1 Make "STRINGER BEADS" and "WEAVE BEADS" in the overhead position

3.8.2 Weld a square-grooved butt joint

3.8.3 Weld a lap joint making a fillet weld

3.8.4 Weld a tee joint making a single-pass fillet weld

3.8.5 Weld a tee joint making a multiple-pass fillet weld

3.8.6 Weld an open corner joint

3.8.7 Weld an edge joint

3.8.8 Weld a single-vee butt joint with a back-up strip

3.8.9 Weld a single-vee butt joint without a back-up strip

3.9 Make Welds on ALUMINUM PIPE

3.9.1 Make weld beads on aluminum pipe on the "ROLLED POSITION" (1G)

3.9.1.1 Weld a pipe joint in the "ROLLED POSITION" (1G)

3.9.2 Make weld beads on aluminum pipe in the "VERTICAL POSITION" (2G)

3.9.2.1 Weld a pipe joint in the "VERTICAL POSITION" (2G)

3.9.3 Make weld beads on aluminum pipe in the "HORIZONTAL-FIXED POSITION" (5G)

3.9.3.1 Weld a pipe joint in the "HORIZONTAL-FIXED POSITION" (5G)

3.9.4 Make weld beads on aluminum pipe in the "45° INCLINED POSITION" (6G)

3.9.4.1 Weld a pipe joint in the "45° INCLINED POSITION" (6G)

3.10 UNDERSTAND FUNDAMENTALS OF WELDING STAINLESS STEELS AND MILD CARBON STEEL

3.10.1 Identify and categorize types of stainless steels and compare to mild steel

3.10.2 Identify and select filler metals for welding stainless steels and mild steel

3.10.3 Clean and prepare stainless steel and mild steel for welding

3.10.4 Select and prepare tungsten electrodes for welding stainless steels and mild steel

3.10.5 Set up and adjust a welding machine and accessories in preparation for welding stainless steel and mild steel

3.11 MAKE WELDS IN THE FLAT POSITION

3.11.1 Make weld beads on stainless steel and mild steel in the flat position

3.11.2 Weld a square-grooved butt joint

3.11.3 Weld a lap joint

3.11.4 Weld a tee joint

3.11.5 Weld a pipe joint in the "ROLLED POSITION" (1G)

3.12 MAKE WELDS IN THE HORIZONTAL POSITION

3.12.1 Make weld beads on stainless steel and mild steel in the horizontal position

3.12.2 Weld a square-grooved butt joint

3.12.3 Weld a lap joint

3.12.4 Weld a tee joint

3.12.5 Weld a pipe joint in the "VERTICAL-TUBE POSITION" (2G)

3.13 MAKE WELDS IN THE VERTICAL POSITION

3.13.1 Make weld beads on stainless steel and mild steel in the Vertical-up position

3.13.2 Weld a square-grooved butt joint

3.13.3 Weld a lap joint

3.13.4 Weld a tee joint

3.13.5 Weld a pipe joint in the "HORIZONTAL-FIXED POSITION" (5g)

3.14 MAKE WELDS IN THE OVERHEAD POSITION

3.14.1 Make weld beads on stainless steel and mild steel in the overhead position

3.14.2 Weld a square-grooved butt joint

3.14.3 Weld a lap joint

3.14.4 Weld a tee joint

3.14.5 Weld a pipe joint in the "45° INCLINED POSITION" (6G)

4.0 GAS METAL-ARC WELDING (GMAW) (MIG)

4.1 Understand the principles of operation of the GMAW process

4.1.1 Recognize and determine the application of MIG welding

4.1.2 Know the fundamentals of the "Short Circuiting Metal Transfer Process"

4.1.3 Know the fundamentals of the "Spray ARC Method"

4.2 Identify safety hazards and comply with safety precautions

4.2.1 Identify general safety rules for MIG welding

4.2.2 Use protective clothing, personal equipment, and proper eye protection

4.2.3 Wear and maintain a welding helmet in compliance with prescribed safety standards

4.3 Identify types of welding machines, accessories, and supplies used for the GMAW process

4.3.1 Identify and set up air-cooled and water-cooled MIG guns, cables, and components

4.3.2 Identify and set up regulators, inert gas hoses, and adjust flowmeters

4.3.3 Identify and set up power sources (welding machines) used for the GMAW process

4.3.4 Identify and select filler metals

4.3.5 Identify and select proper shielding gases

4.3.6 Identify and set up wire feeders

4.4 Set up and adjust GMAW equipment

4.4.1 Set up and adjust welding machine, wire feeder, MIG gun, filler metal, and shielding gas in preparation for welding <u>mild steel</u>

4.4.2 Set up and adjsut a welding machine, wire feeder, MIG gun, filler metal, and shielding gas in preparation for welding <u>aluminum</u>

4.4.3 Set up and adjust a welding machine, wire feeder, MIG gun, filler metal, and shielding gas in preparation for welding <u>stainless steel</u>

4.4.4 Replace an empty spool of filler wire on a wire feeder

4.4.5 Replace an empty compressed gas cylinder

4.5 Make welds on <u>Mild Steel</u> in the <u>Flat</u> position

4.5.1 Weld stringer beads

4.5.2 Weld a square grooved butt joint

4.5.3 Weld a lap joint making a fillet weld

4.5.4 Weld a tee joint making a fillet weld

4.5.5 Weld a single-vee butt joint with a back-up strip

4.5.6 Weld a single-vee butt joint without a back-up strip

4.6 Make welds on Mild Steel in the Horizontal position

4.6.1 Weld stringer beads

4.6.2 Weld a square grooved butt joint

4.6.3 Weld a lap joint making a fillet weld

4.6.4 Weld a tee joint making a fillet weld

4.6.5 Weld a single-vee butt joint with a back-up strip

4.6.6 Weld a single-vee butt joint without a back-up strip

4.7 Make welds on Mild Steel in the Vertical position

4.7.1 Weld stringer beads

4.7.2 Weld a square grooved butt joint

4.7.3 Weld a lap joint making a fillet weld

4.7.4 Weld a tee joint making a fillet weld

4.7.5 Weld a single-vee butt joint with a back-up strip

4.7.6 Weld a single-vee butt joint with a back-up strip

4.8 Make welds on Mild Steel in the Overhead position

4.8.1 Weld stringer beads

4.8.2 Weld a square grooved butt joint

4.8.3 Weld a lap joint making a fillet weld

4.8.4 Weld a tee joint making a fillet weld

4.8.5 Weld a single-vee butt joint with a back-up strip

4.8.6 Weld a single-vee butt joint without a back-up strip

4.9 Make welds on mild steel pipe

4.9.1 Make weld beads on mild steel pipe on the "ROLLED POSITION" (1G)

4.9.1.1 Weld a pipe joint in the "ROLLED POSITION" (1G)

4.9.2 Make weld beads on mild steel pipe in the "VERTICAL TUBE POSITION" (2G)

4.9.2.1 Weld a pipe joint in the "VERTICAL TUBE POSITION" (2G)

4.9.3 Make weld beads on mild steel pipe in the "HORIZONTAL-FIXED POSITION" (5G)

4.9.3.1 Weld a pipe joint in the "HORIZONTAL-FIXED POSITION" (5G)

4.9.4 Make weld beads on mild steel pipe in the "45° INCLINED POSITION" (6G)

4.9.4.1 Weld a pipe joint in the "45° INCLINED POSITION" (6G)

4.10 Make welds on ALUMINUM in the FLAT position

4.10.1 Weld stringer beads

4.10.2 Weld a square grooved butt joint

4.10.3 Weld a lap joint making a fillet weld

4.10.4 Weld a tee joint making a fillet weld

4.10.5 Weld a single-vee butt joint with a back-up strip

4.10.6 Weld a single-vee butt joint without a back-up strip

4.11 Make welds on ALUMINUM in the HORIZONTAL position

4.11.1 Weld stringer beads

4.11.2 Weld a square grooved butt joint

4.11.3 Weld a lap joint making a fillet weld

4.11.4 Weld a tee joint making a fillet weld

4.11.5 Weld a single-vee butt joint with a back-up strip

4.11.6 Weld a single-vee butt joint without a back-up strip

4.12 Make welds on ALUMINUM in the VERTICAL position

4.12.1 Weld stringer beads

4.12.2 Weld a square grooved butt joint

4.12.3 Weld a lap joint making a fillet weld

4.12.4 Weld a tee joint making a fillet weld

4.12.5 Weld a single-vee butt joint with a back-up strip

4.12.6 Weld a single-vee butt joint without a back-up strip

4.13 Make welds on Aluminum in the Overhead position

4.13.1 Weld stringer beads

4.13.2 Weld a square grooved butt joint

4.13.3 Weld a lap joint making a fillet weld

4.13.4 Weld a tee joint making a fillet weld

4.13.5 Weld a single-vee butt joint with a back-up strip

4.13.6 Weld a single-vee butt joint without a back-up strip

4.14 Make welds on Aluminum pipe

4.14.1 Make weld beads on aluminum pipe on the "ROLLED POSITION" (1G)

4.14.1.1 Weld a pipe joint in the "ROLLED POSITION" (1G)

4.14.2 Make weld beads on aluminum pipe in the "VERTICAL TUBE POSITION" (2G)

4.14.2.1 Weld a pipe joint in the "VERTICAL TUBE POSITION" (2G)

4.14.3 Make weld beads on aluminum pipe in the "HORIZONTAL-FIXED POSITION" (3(

4.14.3.1 Weld a pipe joint in the "HORIZONTAL-FIXED POSITION" (3G)

4.14.4 Make weld beads on aluminum pipe in the "45° INCLINED POSITION" (4G)

4.14.4.1 Weld a pipe joint in the "45° INCLINED POSITION" (4G)

5.0 FLUX-CORED ARC WELDING (FCAW)

5.1 Understand the principles of operation of the FCAW process

5.1.1 Recognize and determine the application of flux-cored arc welding

5.2 Identify safety hazards and comply with safety precaution

5.2.1 Use protective clothing, personal equipment, and proper eye protection

5.2.2 Wear and maintain a welding helmet in compliance with prescribed safety standards

5.3 Identify types of welding machines, accessories, and supplies used for for the FCAW process

5.3.1 Identify and set up air-cooled and water-cooled MIG guns, cables, and components

5.3.2 Identify and set up regulators, inert gas hoses, and adjust flowmeters

5.3.3 Identify and set up power sources (welding machines) used for the FCAW process

5.3.4 Identify and select filler metals

5.3.5 Identify and select proper shielding gases

5.3.6 Identify and set up wire feeders

5.4 Set Up and Adjust FCAW Equipment

5.4.1 Set up and adjsut a welding machine, wire feeder, welding gun, filler metal, and shielding gas in preparation for welding mild steel

5.5 Make Welds on Mild Steel in the Flat Position

5.5.1 Weld stringer beads

5.5.2 Weld a lap joint making a fillet weld

5.5.3 Weld a tee joint making a fillet weld

5.5.4 Weld a single-vee groove butt joint with a backing strip

5.6 Make Welds on Mild Steel inthe Horizontal Position

5.6.1 Weld a lap joint making a fillet weld

5.6.2 Weld a tee joint making a fillet weld

5.7 Make Welds on Mild Steel in the Vertical Position

5.7.1 Weld a lap joint making a fillet weld

5.7.2 Weld a tee joint making a fillet weld

5.7.3 Weld a single-vee groove butt joint with a backing strip

6.0 WELDING SHOP GENERAL EQUIPMENT AND TOOLS

6.1 Identify and use hand tools

6.1.1 Know and follow safety precautions when using hand tools

6.1.2 Identify common hand tools and their uses

6.1.3 Inspect and repair hand tools

6.2 Identify, and use power tools and power equipment, in a safe manner

6.2.1 Operate electric hand drills

6.2.2 Operate a drill press

6.2.2.1 Sharpen drill bits

6.2.2.2 Perform maintenance on a drill press

6.2.3 Operate a pedastal grinder and wire wheel

6.2.3.1 Perform maintenance on a pedastal grinder

6.2.4 Operate portable disc grinders/sanders

6.2.4.1 Perform repairs on grinders/sanders

6.2.5 Operate a horizontal and vertical band saw

6.2.5.1 Perform maintenance on a band saw

6.2.6 Operate a power cut-off wheel

6.2.6.1 Perform maintenance on a cut-off wheel

6.2.7 Operate a hydraulic power shear

6.2.7.1 Perform maintenance on a power shear

6.2.8 Operate a hydraulic iron worker

6.2.8.1 Perform maintenance on an iron worker

6.2.9 Scrape and paint machines

6.3 Perform periodic maintenance and make repairs on welding and cutting equipment

6.3.1 Estimate cost of repairs

6.4 Inspect work area for safe working enviornment

7.0 SPECIAL WELDING AND CUTTING PROCESSES

7.1 Study and describe special welding processes

7.1.1 Describe submerged ARC welding

7.1.2 Describe electroslag and electrogas welding

7.1.3 Describe stud welding

7.1.4 Describe ARC spot welding

7.1.5 Describe atomic hydrogen welding

7.1.6 Describe plasma ARC welding

7.1.7 Describe thermit welding

7.1.8 Describe forge welding

7.1.9 Describe cold welding

7.1.10 Describe ultrasonic welding

7.1.11 Describe electron beam welding

7.1.12 Describe friction welding

7.1.13 Describe explosive welding

7.1.14 Describe laser welding

7.2 Study and describe special cutting processes

7.2.1 Describe oxygen lance cutting principles, equipment, and procedures

7.2.2 Describe oxygen-fuel gas underwater cutting principles, equipment and procedures

7.2.3 Describe oxygen-ARC underwater cutting principles, equipment, and procedures

7.2.4 Describe powder cutting principles, equipment, and procedures

7.2.5 Describe plasma-ARC cutting (PAC) principles, equipment, and procedures

8.0 INSPECTING, TESTING WELDS, PROCEDURES, AND WELDER QUALIFICATIONS

8.1 Understand the types of Non-Destructive Tests and classify the methods of testing.

8.1.1 Describe and define "Visual Inspection"

8.1.2 Describe and define "Magnetic Particle Inspection"

8.1.3 Describe and define "Liquid Penentrant Inspection"

8.1.4 Describe and define "Ultrasonic Inspection"

8.1.5 Describe and define "X-Ray Inspection"

8.1.6 Describe and define "Eddy-Current Inspection"

8.2 Understand the types of Destructive Tests and classify the methods of testing

8.2.1 Describe and define Bend Tests

8.2.2 Describe and define Impact Tests

8.2.3 Describe and define the Tensile Test

8.2.4 Describe and define the Microscopic Test

8.2.5 Describe and define the Macroscopic Test

8.2.6 Describe and define Hardness Testing

8.2.7 Describe and define Chemical Analysis Testing

8.3 Describe and Define welder qualification and welding procedures

8.3.1 Name associations, societies, and qovernmental agencies responsible for establishing codes and standards

8.3.2 Name organizations responsible for establishing standards for welding equipment

8.3.3 Name and differentiate procedure qualifications and operator qualifications

8.3.4 Review the American Welding Society "Structural Steel Welding Code"

9.0 PRODUCTION OR METALS, METAL PROPERTIES AND IDENTIFICATION

9.1 Study the methods of manufacturing steel

9.1.1 Study the history of steel manufacturing

9.1.2 Study the operation of the open hearth furnace

9.1.3 Study the operation of the bessemer converter

9.1.4 Study the operation of the basic oxygen furnace

9.1.5 Study the operation of the electric furnace

9.1.6 Study the operation of the vacuum furnace

9.2 Study the manufacturing of stainless steels

9.3 Study the manufacturing of copper

9.4 Study the manufacturing of brass and bronze

9.5 Study the manufacturing of aluminum

9.6 Study the processing of metals

9.6.1 Describe casting

9.6.2 Describe hot and cold rolling

9.6.3 Describe forging

9.6.4 Describe extruding

9.6.5 Describe drawing

9.7 Study metal properties and indentification of ferrous metals

9.7.1 Study and identify physical properties of iron and steel

9.7.2 Study and identify alloy metals

9.7.3 Study and analyze spark tests

9.7.4 Study and analyze torch tests

9.7.5 Study and analyze chemical tests

9.7.6 Identify the S.A.E. numbering systems for metals

9.8 Study metal properties and identification non ferrous metals

9.8.1 Define non ferrous metals

9.8.2 Compare and identify copper

9.8.3 Compare and identify brass

9.8.4 Compare and identify bronze

9.8.5 Compare and identify aluminum

9.8.6 Compare and identify hard surfacing metals

9.8.7 Compare and identify other elements

9.9 Study the heat treatment of metals

9.9.1 Name the purpose of heat treatment

9.9.2 Name the methods of heat treatment

9.9.3 Name the methods of cooling

9.9.4 Identify the various carbon contents of steel

9.9.5 Identify the crystalline structure of steel

9.9.6 Describe annealing of steel

9.9.7 Describe hardening of steel

9.9.8 Describe tempering (drawing) of steel

9.9.9 Describe casehardening

9.9.10 Name temperature measuring

9.9.11 Heat treat various metals

10.0 UNDERSTAND AND PERFORM BLUEPRINT READING SKILLS AND TASKS FOR WELDERS

10.1 Interpret and draw basic lines

10.2 Interpret and draw basic views

10.3 Interpret and recognize notes and specifications

10.4 Calculate, identify, and write dimensions

10.5 Interpret and identify structural shapes

10.6 Interpret and identify other views

10.7 Interpret and identify sections

10.8 Interpret and identify detail and assemble prints

10.9 Identify and recognize general abbreviations and symbols

10.10 Understand components of the welding symbol

10.11 Understand and recognize welding abbreviations

10.12 Identify, interpret and draw the fillet weld symbol

10.13 Identify, interpret and draw the groove weld symbol

10.14 Identify, interpret and draw the back or backing and melt-thru symbols

10.15 Identify, interpret and draw the plug and slot weld symbols

10.16 Identify, interpret and draw the surfacing seld and flash or upset weld symbols

10.17 Identify, interpret and draw the flange weld symbol

10.18 Identify, interpret and draw the spot weld symbol

10.19 Identify, interpret and draw the projection weld symbol

10.20 Identify, interpret and draw the seam weld and nonpreferred welding symbols

11.0 Apply the principles of practical problems in mathamatics related to the work of a welder

11.1 Compute whole numbers

11.1.1 Add whole numbers

11.1.2 Subtract whole numbers

11.1.3 Multiply whole numbers

11.1.4 Divide whole numbers

11.2 Compute common fractions

11.2.1 Interpret common fractions

11.2.2 Identify fractional divisions of the steel tape

11.2.3 Add common fractions

11.2.4 Subtract common fractions

11.2.5 Multiply common fractions

11.2.6 Divide common fractions

11.3 Compute decimal fractions

11.3.1 Interpret decimal fractions

11.3.2 Add and subtract decimal fractions

11.3.3 Multiply decimal fractions

11.3.4 Divide decimal fractions

11.3.5 Round off decimal fractions

11.3.6 Change fractions and decimals

11.4 Compute linear measure

11.4.1 Convert linear measure into larger and smaller units

11.4.2 Add and subtract units of linear measure

11.4.3 Multiply and divide units of linear measure

11.4.4 Use the metric system

11.4.5 Identify english-metric equivalents

11.4.6 Compute perimeters of rectangles

11.4.7 Compute perimeters of circles and semicircular sided figures

11.5 Compute angular measures

11.5.1 Identify units of angular measure

11.5.2 Use the protractor

11.6 Compute surface measurement

11.6.1 Compute areas of squares and rectangles

11.6.2 Compute areas of triangles and trapezoids

11.6.3 Compute areas of circular figures

11.7 Compute volume measure, capacity, and weight

11.7.1 Compute volumes of cubes and rectangle solids

11.7.2 Compute volumes of cylindrical solids

11.7.3 Compute capacities of rectangular structures

11.7.4 Compute capacities of cylindrical and complex structures

11.7.5 Compute weights of steel structures

11.8 Compute averages and percents

11.8.1 Compute averages

11.8.2 Compute percentages

11.9 Compute pieces and lengths

11.9.1 Estimate strecthouts of square and rectangular shapes

11.9.2 Estimate strecthouts of circular and semicircular shapes

11.9.3 Estimate economical layouts of rectangular plates for welding

11.9.4 Estimate economical layouts of odd-shaped plates

11.10 Compute wages and salary

11.10.1 Determine salary and hours

11.10.2 Compute overtime salary

11.10.3 Compute piecework rates

11.10.4 Compute yearly wages with benefits

11.10.5 Compute take home pay

12.0 SUPERVISION, TRAINING, AND ESTIMATING

12.1 Perform Supervisory Functions, Conduct Training Sessions and Make Estimates

12.1.1 Assign work to others

12.1.2 Plan and schedule work assignments

12.1.3 Assign custodial tasks, sweep, and clean shop facility

12.1.4 Clean and maintain work and adjacent work areas

12.1.5 Supervise manchine use and operation

12.1.6 Supervise maintenance of shop safety equipment, safe operations, and set up of machinery

12.1.7 Dispose of scrap metal, chips of shavings, and trash of waste material

12.1.8 Write performance standards for job

12.1.9 Conduct oral safety briefings

12.1.10 Prepare accident reports

12.1.11 Follow-up on end product quality control standards

12.1.12 Inventory supplies and material

12.1.13 Determine availability of supplies and materials, maintain files, order and received new shipment of supplies

12.1.14 Estimate labor and material costs of new fabrications

12.1.15 Review and research technical publications and journals

Lehigh County Vocational-Technical School

PHILOSOPHY

The Lehigh County Vocational-Technical School is a public institution which derives its authority from the nine sponsoring school districts through a Joint Operating Committee composed of representatives of the school boards from those sponsoring districts.

The philosophy of the Lehigh County Vocational-Technical School is based upon the belief that:

1. A major purpose of public education in the United States is to educate all persons regardless of race, creed, national origin, gender or physical limitation to the maximum of their individual abilities.

2. All persons should have an opportunity to participate fully in the educational system in general, and in the curriculum of the Lehigh County Vocational-Technical School, in particular.

3. Full participation in the educational system will make possible the maximum development of that greatest natural resource, our young people, and will continue to provide national strength.

The increased interest in vocational education and in enrollment indicate that the Lehigh County Vocational-Technical School must meet the vocational need of the community and must continue to work cooperatively with other segments of the educational system. The philosophy requires that the Lehigh County Vocational-Technical School provide: (1) that general education of values, attitudes and skills required of contributing members of a democratic society, (2) those specific vocational interests and skills required by business, industry and human services, (3) those proper attitudes concerning the dignity of work, (4) those contributions which a skilled and effective labor force make to society and to the economy of the country by gainful employment.

The school is sensitive to its responsibility to be apprised of those changes in the employment climate which require an understanding of employment opportunities, evaluation of occupational trends, close working relationships with the management and labor community, and a knowledge of the skills and potential of those students completing its programs. The function of the school is to provide well-trained personnel and modern facilities and equipment to train both secondary school students and to train, retrain and upgrade interested members of the adult community in both vocational and avocational pursuits. This basic philosophy of education and the operational objectives which emanate from it will enable students to adapt to those technological changes which will be demanded in the future and will insure that the Lehigh County Vocational-Technical School will play a major role in the future of society by: (1) providing a high quality labor force, (2) assisting in maintaining a high rate of industrial production, and (3) contributing to a higher standard of living.

LEHIGH COUNTY AREA VOCATIONAL TECHNICAL SCHOOL

WELDING

COURSE PHILOSOPHY

This welding course is designed to give students a fundamental background in the major aspects of the welding trade. The emphasis is on each participant to master manipulative skills to develop successful welding techniques, and to also gain an understanding of the specialized tools and equipment being used in the welding field.

Training, in the development of leadership abilities, technical knowledge, and related occupational information, is given to prepare the individual for initial employment in the welding trade and related occupations. Each student progresses at his own rate as demonstrated by his ability and application. In this type of instruction, a great deal of emphasis is placed on individual instruction, demonstration, and application.

Curriculum content and competencies were developed through an analysis of the welding occupation. Flexible entry and exit for the individual is a characteristic of the course. The course provides assistance to students in job placement and follow-up. Special emphasis is placed on safety, leadership qualities, the individual's need to meet the needs of society, and employee-employer relations.

Lehigh County Vocational-Technical School

OBJECTIVES

The philosophy of the school will be attained through the following objectives:

1. To broaden, extend and enrich the secondary school curriculum to include technical, skilled and operative level courses for both boys and girls.

2. To provide a diversified program of vocational and technical education in order that boys and girls may have the opportunity to learn basic occupational skills commensurate with their aptitudes and interests.

3. To conduct the school as a part of all participating schools in order that progress in vocational courses may be closely related to progress in general and academic studies.

4. To provide for transition from school to employment through program offerings which correspond to the needs of the community and the interests and aptitudes of the student.

5. To develop proper attitudes concerning the contributions of workers to our society.

6. To provide for a program of occupational orientation and counseling which will inform the student of employment opportunities and occupational trends.

7. To provide flexible selection and admission guide lines which will permit placement of the student as determined by the combined judgement of the counselors, teachers and principals of the participating schools.

8. To conduct the school as a community enterprise by working closely with advisory committees in providing a continuous review of employment needs, course content, procedures and other matters required to maintain an up-to-date program.

9. To provide part-time and full-time programs for adults as required to prepare them for technological changes.

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LEHIGH COUNTY AREA VOCATIONAL TECHNICAL SCHOOL

WELDING

COURSE OBJECTIVES

1. To perform the basic manipulative skills involved in the occupation.
2. To acquaint the student with the skill and knowledge required to prepare him for useful employment in the trade.
3. To develop an appreciation of the welder's importance and the opportunities in industry.
4. To understand the history and development of the welding industry.
5. To acquire a working knowledge of the machine and equipment used in the welding trade.
6. To know the safety procedures and practices in the trade.
7. To understand the proper care and maintenance of welding equipment and accessories.
8. To obtain a basic knowledge of the correct practices and usage of equipment and accessories.
9. To be familiar with the terms and definitions of the trade.
10. To understand the characteristics of the arc and the flame--the actual tools of the trade.
11. To acquire a knowledge of the techniques involved in arc and gas welding and oxygen cutting.
12. To have an understanding of the elementary principles of electricity.
13. To have an understanding of shielded and unshielded electrodes and rods.
14. To have and understanding of metallic elements and their alloys.
15. To understand the metallurgy of ferrous alloys.
16. To be able to read blueprints for welders.
17. To learn the principles of practical problems in mathematics related to the welding occupation.
18. To have an understanding of the fabrication of metals.
19. To learn the common methods of testing welds.
20. To develop an understanding of the principles of layout work in the metal trades.
21. To develop proper work habits, attitudes and desires to enable students to find and hold jobs.
22. To understand and have respect for employer-employee relationship, and an awareness of the necessity of delivering worthy and loyal service for value received.
23. To help students to be successful citizens in their communities.

Lehigh County Area Vocational Technical School

WELDING
Personal-Social Traits Essential for the Skilled Welder

Personality traits are of extreme importance not only in securing and holding a desirable position but in life in general. Personal and social traits can be improved through training when the individual learns what to improve, how to improve and why improvement is advisable. Among the personal-social traits of value to the welder are the following:

Physical Condition - Physical requirements are not excessive but one must have good muscular coordination, mechanical dexterity, good eyesight and steady nerves. Often it is necessary for the welder to work in areas where working conditions are unfavorable such as cold, windy and poorly ventilated places. One must keep in good physical condition to keep at top efficiency.

Personal Appearance - Clothing should be worn that makes for safety, efficiency, and a pleasing impression upon the people you serve.

Safety-conscientiousness - The nature of welding with its many possible hazards requires a competent individual as well as one who puts safety practices first in his order of actions. He is constantly working hot metals, open flames, arc rays, toxic fumes, explosive gases, pressurized cylinders, excessive electrical currents and many other factors which make his occupation hazardous if safety practices are not employed.

Patience - Much of the welders work involves problem-solving situations which require considerable patience as well as abilities to make the correct preparations, adjustments and applications.

Cooperation - Many welding operations are done in cooperation with other metal workers in numberous jobs and occupations. It is important for the welder to develop a cooperative attitude toward his fellow workers and assist them when they need help.

Industry - This important character trait reflects the individual's attitude and behavior in planning, organizing, and executing his work effectively and efficiently.

Initiative: This trait is best described as willingness to work. A competent welder has the ability to see what needs done and does it carefully and effectively without constant supervision.

Responsibility: In the welding occupation especially the worker must have a sense of responsibility toward himself and others. Since his area of work is very hazardous, negligence on his part could be disastrous to himself and others.

LEHIGH COUNTY AREA VOCATIONAL TECHNICAL SCHOOL

WELDERS

COURSE DESCRIPTION

This course emphasises shielded metal-arc welding, oxy-acetylene welding and cutting, gas tungstem-arc welding, gas metal-arc welding, flux-cored arc welding, and other related commonly used welding, cutting, and brazing processes. The student will learn how to weld various types of commercial metals commonly used today while using the best suited welding process.

Each student will have an opportunity to use the tools and equipment in the welding trade and to learn how to perform the operation of the trade including the evaluation of the completed work.

The student will have welding shop experience not only in the mastery of manipulative skills but also related information or technology. Under the direction of the shop teacher the student will learn related information in order that he may have a complete understanding of why he performs the operations of the trade in certain ways.

The course will include related subjects consisting of mathematics, science and drawing related to the welding trade. Here emphasis will be placed on the mastery of fundamental concepts and principles as well as the ability to solve practical problems. These related subjects will help to provide the foundation which makes the shop work meaningful and functional.

It is expected that the student will have sufficient knowledge of the trade to enable him to enter into satisfactory employment upon completion of the course and/or be able to begin apprenticeship training in preparation for more advanced phases of the trade.

Lehigh County Area Vocational Technical School

WELDING

Entry Level Jobs

D O T CODE NUMBERS	D O T TITLES
810.384-014	Welder, ARC
810.684-010	Welder, Tack
811.684-014	Welder, Gas
013.684-010	Brazer, Assemabler
816.364-010	ARC Cutter
816.464-010	Thermal Cutter, Hand I
819.361-014	Welder-Fitter Apprentice
819.384-010	Welder Combination
819.684-010	Welder, Production Line
819.687-014	Welder Helper

Lehigh County Area Vocational Technical School

WELDING

POSSIBLE JOBS WITH ADDITIONAL TRAINING

D O T CODE NUMBERS	D O T TITLES
810.382-010	Welding-machine operator, arc
813.482-010	Brazer, furnace
815.382-010	Welding- machine operatro, elecron beam
815.382-014	Welding-machine operator, electroslag
815.682-010	Laser-beam machine operator
816.482-010	Thermal-cutting-machine operator
816.684-010	Thermal cutter, hand
819.131-014	Welding, supervisor
819.281-018	Weld inspector
819.281-022	Welder, experimental
819.361-010	Welder-fitter
819.685-010	Welding-machine tender

Lehigh County Area Vocational Technical School

WELDING

Job Descriptions

810.382-014 WELDER, ARC (welding)

Welds together metal components of such products as pipelines, automobiles, boilers, ships, aircraft, and mobil homes, as specified by layout, blueprints, diagram, work order, welding procedrues, or oral instructions, using electric arc-welding equipment: Obtains specified electrode and inserts into portable holder or threads consumable electrode wire through portable welding gun. Connects cables from welding unit to obtain amperage, voltage, slope, and pulse, as specified by WELDING ENGINEER (profess. & kin.) or WELDING TECHNICIAN (profess. & kin.). Starts power supply to produce electric current. Strikes (forms) arc which generates heat to melt and deposit metal from electrode to workpiece and join edges of workpiece. Manually guides electrode or gun along weld line, maintaining length of arc and speed of movement to form specified depth of fusion and bead, as judged from color of metal, sound of weld, and size of molten puddle. Welds in flat, horizontal, vertical, or overhead positions. Examines weld for bead size and other specifications. May manually apply filler rod to supply weld metal. May clean or degrease weld joint or workpiece, using wire brush, portable grinder, or chemical bath. May repair broken or cracked parts and fill holes. May prepare broken parts for welding by grooving or scarfing surfaces. May chip off excess weld, slag, spatter, using hand scraper or power chipper. May preheat workpiece, using hand torch or heating furnace. May position and clamp workpieces together or assemble them in jig or fixture. May tack assemblies together. May cut metal plates or structural shapes (ARC CUTTER (welding). May be designated according to type of equipment used as WELDER, CARBON ARC (welding); WELDER, FLUX-CORED ARC (welding); WELDER, GAS-METAL ARE (welding); WELDER, GAS-TUNGSTEN ARC (welding); WELDER, HAND, SUBMERGED ARC (welding); WELDER, PLASMA ARC (welding); WELDER, SHIELDED-METAL ARC (welding) May be designated according to product welded as WELDER, BOILERMAKER (boilmaking). Important variations include types of metals welded, subprocesses used, trade name of equipment used, worksite (inplant, job ship, construction site, shipyard), method of application (manual, semiautomatic), high production or custom, level of ambidexterity required, type of joints welded (seam, spot, butt). May be required to pass employer performance tests or standard tests to meet certification standards of governmental agencies or professional and technical associations.

810.684-010 WELDER, TACK (welding)tacker

Welds short beads at points specified by layout, welding diagram, or by FITTER (any ind.) I, along overlapping edges of metal parts to hold parts in place for final welding. Performs tasks of FITTER HELPER (any ind.). May tack-weld, using hand, submerged, or gas-shielded arc welding equipment. May tack weld, using portable spotwelding gun (WELDER, GUN) (welding).

811.684-014 WELDER, GAS (welding)

Welds metal parts, using gas welding equipment as specified by layouts, welding diagram, or work order: Positions parts in jigs or fixtures on bench or floor, or clamps parts together along layout marks. Selects torch, torch tip, filler rod and flux, according to welding chart specifications or types and thickness of metal. Connects regulator valves and hoses to oxygen and fuel gas cylinders, and welding torch. Turns regulator valves to activate flow of gases, lights torch and adjusts gas mexture and pressure, to obtain desired flame, based on knowledge of gas-welding techniques. Holds torch at proper angle to metal and guides along weld joint, applying filler rod to molten area to form weld. Examines weld for bead size and other specifications. Repairs broken or cracked metal objects, fills holes, and builds up metal parts. May apply flux to workpiece instead of filler rod. May preheat workpiece in furnace or with torch. May layout, position and tack weld workpieces. May weld along vertical or overhead weld lines. May scarf or groove weld prior to applying filler metal, using gas welding equipment. May chip or grind off excess weld, slag, or spatter (GRINDER-CHIPPER) (any ind.)II). May clean or degrease parts, using wire brush, portable grinder, or chemical bath. May cut metal plates or structural shapes using gas torch. May be designated according to types of gases used such as WELDER, ACETYLENE (welding); WELDER, OXYACETYLENE (welding); WELDER, OXYHYDROGEN (welding);. Important variations include type of metals welded, products, subprocesses, trade name of equipment, worksite (inplant, job shop, construction site, shipyard), high-production or custom, level of ambidexterity required or type of joints welded (seam, spot, butt). May be required to pass employer performance test or standard tests to meet certification standards of governmental agencies or professional and technical associations.

813.684-010 BRAZER, ASSEMBLER (welding)
brazer; torch brazer.

Brazes (bonds) together components to assemble metal parts as specified by layout, work order, or blueprints, using hand torch: Alines and clamps workpieces together, using rule, square, or template or sets up and places them in fixtures, jigs, or vise. Cleans joints of workpieces.

816.364-010 ARC CUTTER (welding) arc-air
operator; burn-out-scarfing operator

Cuts, trims, or scarfs metal objects to dimensions, contour, or bevel specified by blueprints, work order, or layout, using arc-cutting equipment: Positions workpiece onto table or into fixture or with jib or crane. Selects carbon or metal-coated carbon electrode, gas nozzle, metal, data on charts, or record of previous runs. Inserts electrode and gas supply. Connects cables from power source to electrode and work-piece or fixture, to obtain desired polarity. Turns knobs to select amperage. Turns lever to adjust jet of gas to blow away molten metal. Strikes arc and guides electrode along lines to cut (melt) through metal. May cut off chips or sprues and burn out cracks and holes. May use nonconsumable tungsten electrode and gases, such as helium or carbon dioxide, and be designated ARC CUTTER, GAS-TUNGSTEN ARE (welding). May use plasma-arc cutting torch and gases, such as nitrogen and carbon dioxide, and be designated ARC CUTTER, PLASMA ARC (welding).

816.464-010 THERMAL CUTTER, HAND
I burner, hand; cutter, gas; flame gouger; torch cutter. (welding).

Cuts, trims, or scarfs metal objects to dimensions, contour, or bevel specified by blueprints, layout, work order, or oral instructions, using thermal-cutting equipment: Lifts and positions workpiece onto table, manually or using jib or crane. Connects hoses from torch to oxygen tank and fuel gas tank, such as acetylene or propane. Selects torch tip, gas pressures, speed of cut, and allows for width of cut, according to thickness and types of metal as computed from charts. Installs torch tip and turns handle to start and adjust pressure of fuel gas. Lights torch and adjusts flow of oxygen to obtain desired mixture, as indicated by color and size of flame. Directs flame on workpiece to heat it to oxidizing temperature, as indicated by color of metal. Squeezes lever of trigger to release additional jet of oxygen which burns path through metal. Guides flame along cutting line, observing cutting to judge angle, distance or torch, and speed of movement. Removes and inspects finished workpiece. Chips or grinds burs from edges, using power chisel or portable grinder. May lay out cutting lines, using rule, square, compass, or by tracing from template. May cut damaged or worn pieces from metal structure, such as bridge or building frames, ship plates,

or pipelines. May install special tip to cut grooves into metal joints, preparatory to welding, and be designed as FLAME SCARFER (welding).

819.361-014 WELDER-FITTER APPRENTICE (welding)

Performs duties as described under APPRENTICE (any ind.).

APPRENTICE (any ind.)

A worker who learns, according to written or oral contractual agreement, a recognized skilled craft or trade requiring one or more years of on-the-job training through job experience supplemented by related instruction, prior to being considered a qualified skilled worker. High school or vocational school education is often a prerequisite for entry into an apprenticeship program. Provisions of apprenticeship agreement regularly include length of apprenticeship; a progressive scale of wages; work processes to be taught; and amount of instruction in subjects related to the craft or trade is best evidenced by its acceptability for registration as a trade by a State apprentceship agency or the Federal Bureau of Apprenticeship and training. Generally, where employees are represented by a union, apprenticeship programs come under the guidance of joint apprenticeship committees composed of representatives of the employers or the employer association and representatives of the employees. These committees may determine need for apprentices in a locality and establish minimum apprenticeship standards of education, experience, and training. In instances where committees do not exist, apprenticeship agreement is made between apprentice and employer, or an employer group. The title, APPRENTICE, is often loosely used as a synonym for beginner, HELPER (any ind.), or TRAINEE (any ind.). This practice is technically incorrect and leads to confusion in determining what is meant. Typical classifications for apprentices are BLACKSMITH APPRENTICE (forging): MACHINISH APPRENTICE (mach. shop); and PLUMBER APPRENTICE (const.).

819.381-010 WELDER, COMBINATION (welding)

Welds metal components together to fabricate or repair products, such as machine parts, plant equipment, mobile homes, motors, and generators, according to layouts, blueprints, or work orders, using brazing and variety of arc and gas welding equipment: Welds metal parts together, using both gas welding (WELDER, GAS (welding)) or brazing BRAZER, ASSEMBLER (welding). Performs related tasks, such as thermal cutting and grinding. Repairs broken or cracked parts, fills holes, and increases size of metal parts. Positions and cloamps together components of fabricated metal products preparatory

to welding. May locate and repair cracks in industrial engine cylinder heads, using inspection equipment and gas torch, and be designated REPAIRER, CYLINDER HEADS (welding). May perform repairs only, and be designated WELDER, REPAIR (welding). May be required to pass employer performance tests or standard tests to meet certification standards or governmental agencies or professional and technical associations.

819.684-010 WELDER, PRODUCTION LINE (welding)

Welds metal parts on production line, using previously set up gas-or arc-welding equipment: Turns valves to release fuel gas and oxygen and ingites mixture, or inserts specified weld rod into portable holder, clamps cable onto workpiece or jig, and strikes arc. Guides electrodes, or torch and filler rod, along horizontal weld line at specified speed and angle to melt from filler rod or electrode onto workpiece. May skip (tack) weld designated spots to secure workpieces for other welders. May use different equipment and be designated as BRAZER, PRODUCTION LINE (welding); WELDER, PRODUCTION LINE, ARC (welding); WELDER, PRODUCTION LINE, COMBINATION (welding); WELDER, PRODUCTION LINE, GAS (welding).

819.687-010 WELD INSPECTOR (welding) II

Inspects welded or soldered joints and seams for defects, such as cracks, cold weld, spatter, and undercuts: Tests joints or seams, using either of following methods: 1. Connects test-fittings to pipe, turns valve to admit compressed air, and immerses pipe in water, or brushes soapy water onto pipe to locate leaks.
2. Probes soldered joints, using pointed tool, to locate defects. Marks location of defects, using crayon, and routes defective parts to repair area. May use dye penetrants or magna-flux equipment during inspection.

LEHIGH COUNTY VOCATIONAL-TECHNICAL SCHOOL
INSTRUCTIONAL TASK IDENTIFICATION

Welding

TASKS	V-TECS TASK NOS.	D. O. T. JOB CLASSIFICATIONS									
		1	2	3	4	5	6	7	8	9	10
		810.384-014 Welder, ARC	810.684-010 Welder, Tack	811.684-014 Welder, Gas	813.684-010 Brazer, Assembler	816.364-010 ARC Cutter	816.464-010 Thermal Cutter, Hand I	819.361-014 Welder-Fitter Apprentice	819.384-010 Welder, Combination	819.684-010 Welder, Production line	819.687-014 Welder Helper
Recognize & apply principles of oxyacetylene welding				X	X			X	X		X
Recognize & apply principles of oxyacetylene cutting							X				X
Recognize & apply other fuel-gas welding and cutting processes				X	X		X	X	X		X
Identify and comply with general safety precautions for welding (OSHA regulations)		X	X	X	X	X	X	X	X	X	X
Use personnel safety equipment and clothing		X	X	X	X	X	X	X	X	X	X
Establish safe working habits & report safety hazards		X	X	X	X	X	X	X	X	X	X
Identify oxygen and acetylene cylinders and mfg. of gases				X	X		X	X	X		X
Identify and compare regulators				X	X		X	X	X		X
Identify hoses				X	X		X	X	X		X
Identify & compare types of torches				X	X		X	X	X		X

LEHIGH COUNTY VOCATIONAL-TECHNICAL SCHOOL
INSTRUCTIONAL TASK IDENTIFICATION

Welding

TASKS	V-TECS TASK NOS.	D. O. T. JOB CLASSIFICATIONS									
		1	2	3	4	5	6	7	8	9	10
		810.384-014 Welder, ARC	810.684-010 Welder, Tack	811.684-014 Welder, Gas	813.684-010 Brazer, Assembler	816.364-010 ARC Cutter	816.464-010 Thermal Cutter, Hand I	819.361-014 Welder-Fitter Apprentice	819.384-010 Welder, Combination	819.684-010 Welder, Production line	819.687-014 Welder Helper
Identify & compare welding tips				X	X		X	X	X		X
Identify & compare cutting tips				X	X		X	X	X		X
Identify & compare cutting torches				X	X		X	X	X		X
Identify cutting machines				X	X		X	X	X		X
Identify an oxygen and acetylene manifold system				X	X		X	X	X		X
Set up and assemble a portable oxyacetylene welding & cutting outfit and stationary manifold system				X	X		X	X	X		X
Clean a dirty or clogged welding tip				X	X		X	X	X		X
Safely store and use oxygen, acetylene and compressed gas cylinders				X	X		X	X	X		X
Change an empty compressed gas cylinder				X	X		X	X	X		X
Turn on the gases, adjust the pressure settings, and shut down a typical oxyacetylene outfit				X	X		X	X	X		X

LEHIGH COUNTY VOCATIONAL-TECHNICAL SCHOOL

INSTRUCTIONAL TASK IDENTIFICATION

Welding

TASKS	V-TECS TASK NOS.	D. O. T. JOB CLASSIFICATIONS									
		1	2	3	4	5	6	7	8	9	10
		810.384-014 Welder, ARC	810.684-010 Welder, Tack	811.684-014 Welder, Gas	813.684-010 Brazer, Assembler	816.364-010 ARC Cutter	816.464-010 Thermal Cutter, Hand I	819.361-014 Welder-Fitter Apprentice	819.384-010 Welder, Combination	819.684-010 Welder, Production line	819.687-014 Welder Helper
Safetly light the oxy-fuel torch, adjust to various types of flames, and extinguish the torch				X	X		X	X	X		X
Identify welding positions		X	X	X	X			X	X	X	X
Identify and select types of welds and types of joints		X	X	X	X			X	X	X	X
Identify and prevent problems of distortion		X	X	X	X			X	X	X	X
Identify and select filler materials		X	X	X	X			X	X	X	X
Make welds in the flat position (1/8" thickness and thinner)		X	X	X				X	X	X	X
Make welds on heavy plate (3/16" thickness and heavier)		X	X	X				X	X	X	X
Make weld beads with no filler rod (puddling)				X					X		X
Make weld beads using a filler rod				X					X		X
Tack weld various joints (butt, lap, tee, edge, corner)		X	X	X	X			X	X	X	X

LEHIGH COUNTY VOCATIONAL-TECHNICAL SCHOOL
INSTRUCTIONAL TASK IDENTIFICATION

Welding

TASKS	V-TECS TASK NOS.	D. O. T. JOB CLASSIFICATIONS									
		1	2	3	4	5	6	7	8	9	10
		810.384-014 Welder, ARC	810.684-010 Welder, Tack	811.684-014 Welder, Gas	813.684-010 Brazer, Assembler	816.364-010 ARC Cutter	816.464-010 Thermal Cutter, Hand I	819.361-014 Welder-Fitter Apprentice	819.384-010 Welder, Combination	819.684-010 Welder, Production line	819.687-014 Welder Helper
Identify variables affecting weld bead quality		X	X	X				X	X	X	X
Weld an edge joint using no filler rod				X				X	X		X
Weld a corner joint		X	X	X				X	X	X	X
Weld a tee joint making a fillet weld		X	X	X				X	X	X	X
Weld a square groove butt joint		X	X	X				X	X	X	X
Weld a lap joint		X	X	X				X	X	X	X
Weld a single V-butt joint on heavy plate		X	X	X				X	X	X	X
Make horizontal weld beads on a vertical surface		X	X	X				X	X		X
Weld a horizontal-square groove butt joint		X	X	X				X	X		X
Weld a horizontal-lap joint		X	X	X				X	X		X

LEHIGH COUNTY VOCATIONAL-TECHNICAL SCHOOL

INSTRUCTIONAL TASK IDENTIFICATION

Welding

TASKS	V-TECS TASK NOS.	D. O. T. JOB CLASSIFICATIONS									
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		810.384-014 Welder, ARC	810.684-010 Welder, Tack	811.684-014 Welder, Gas	813.684-010 Brazer, Assembler	816.364-010 ARC Cutter	816.464-010 Thermal Cutter, Hand I	819.361-014 Welder-Fitter Apprentice	819.384-010 Welder, Combination	819.684-010 Welder, Production line	819.687-014 Welder Helper
Weld a horizontal tee joint with a single-pass fillet weld		X		X				X	X	X	X
Weld a horizontal-single V-butt weld on ¼"plate or heavier		X		X				X	X	X	X
Make vertical-up weld beads on a vertical surface		X	X	X				X	X	X	X
Weld a vertical-square groove butt weld		X		X				X	X	X	X
Weld a vertical-lap joint		X		X				X	X	X	X
Weld a vertical tee joint with a single pass fillet weld		X		X				X	X	X	X
Weld a vertical-corner joint		X		X				X	X	X	X
Weld a vertical-single V-groove butt weld on ¼" plate or heavier		X		X				X	X	X	X
Make overhead stringer beads		X	X	X				X	X	X	X
Weld an overhead square-groove butt joint		X		X				X	X	X	X

LEHIGH COUNTY VOCATIONAL-TECHNICAL SCHOOL

INSTRUCTIONAL TASK IDENTIFICATION

Welding

D. O. T. JOB CLASSIFICATIONS

TASKS	V-TECS TASK NOS.	1 810.384-014 Welder, ARC	2 810.684-010 Welder, Tack	3 811.684-014 Welder, Gas	4 813.684-010 Brazer, Assembler	5 816.364-010 ARC Cutter	6 816.464-010 Thermal Cutter, Hand I	7 819.361-014 Welder-Fitter Apprentice	8 819.384-010 Welder, Combination	9 819.684-010 Welder, Production line	10 819.687-014 Welder Helper
Weld an overhead lap joint		X	X	X				X	X	X	
Weld an overhead tee joint with a single-pass fillet weld		X	X	X				X	X	X	
Weld an overhead-single V-groove butt weld on ¼" plate or heavier		X						X	X	X	X
Identify pipe weld positions		X	X	X				X	X	X	X
Deposit weld beads on pipe in various positions		X	X	X				X	X		
Weld a pipe joint in the rolled position		X		X				X	X		
Weld a pipe joint in the horizontal fixed position		X		X				X	X		
Weld a pipe joint in the vertical tube position		X		X				X	X		
Weld a pipe joint in the inclined position		X		X				X	X		
Understand principles of brazing		X			X			X	X	X	X

LEHIGH COUNTY VOCATIONAL-TECHNICAL SCHOOL
INSTRUCTIONAL TASK IDENTIFICATION

Welding

TASKS	V-TECS TASK NOS.	D. O. T. JOB CLASSIFICATIONS									
		1	2	3	4	5	6	7	8	9	10
		810.384-014 Welder, ARC	810.684-010 Welder, Tack	811.684-014 Welder, Gas	813.684-010 Brazer, Assembler	816.364-010 ARC Cutter	816.464-010 Thermal Cutter, Hand I	819.361-014 Welder-Fitter Apprentice	819.384-010 Welder, Combination	819.684-010 Welder, Production line	819.687-014 Welder Helper
Recognize the use of flux					X				X	X	X
Select filler materials					X				X	X	X
Identify joint designs (butt, lap, tee, edge, corner)					X				X	X	X
Select and set-up equipment for brazing operations					X				X	X	X
Make braze weld beads					X				X	X	X
Braze a square grooved butt joint					X				X	X	
Braze a lap joint					X				X	X	
Braze a tee joint					X				X	X	
Braze a single-Vee butt joint on heavy plate					X				X	X	
Make horizontal braze weld beads on a vertical surface					X				X	X	

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		810.382-014 Welder, ARC	810.684-010 Welder, tack	811.684-014 Welder, gas	813.684-010 Brazer, assembler	816.364-010 ARC cutter	816.464-010 Thermal cutter, hand I	819.361-014 Welder-fitter apprentice	819.384-010 Welder, combination	819.684-010 Welder, production line	819.687-014 Welder helper
ake vertical braze weld beads (vertical-up technique)					X				X	X	
eposit overhead braze weld beads					X				X	X	
nderstand the fundamentals of silver brazing					X			X	X		
dentify joint design and joint fit-up for silver razing and soft soldering					X			X	X		
dentify filler alloys and fluxes for silver razing and soft soldering					X			X	X		
ilver solder a lap joint on ferous and non-errous metals					X			X	X		
ilver solder a tee joint on ferrous and non-errous metals					X			X	X		
ilver solder a copper tubing joint					X			X	X		

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Soft solder a lap joint on ferrous and nonferrous metals				X	X			X			
Soft solder a tee joint on ferrous and nonferrous metals				X	X			X			
Soft solder a copper tubing joint				X	X			X			
Analyze principles of oxyfuel cutting							X	X			
Recognize and observe safety precautions		X	X	X	X	X	X	X	X	X	X
Perform straight line cutting operations on mild steel						X	X	X	X		
Perform bevel cuts on heavy plate						X	X	X	X		
Pierce holes and cut circles						X	X	X	X		
Perform gouging and scarfing operations						X	X	X	X		
Remove a weld by gouging						X	X	X	X		

LEHIGH COUNTY VOCATIONAL-TECHNICAL SCHOOL

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Remove a backing strip from a test plate by scarfing						X	X	X	X		X
Set up a cutting machine (radiagraph) and make straight line cuts and bevel cuts							X				
Set up a manual pipe cutting machine and make bevel cuts on pipe							X				
Clean a dirty or clogged cutting tip				X	X		X	X	X	X	X
Change a cutting tip on an oxyfuel cutting torch							X	X	X		X
Recognize basic electrical principles		X	X			X		X	X	X	X
Analyze the ARC welding process		X	X			X		X	X	X	X
Name the types of welding current and describe polarity		X	X			X		X	X	X	X
Describe "ARC BLOW" and know the remedies		X	X			X		X	X	X	X
Analyze the effects of welding heat on metals		X	X			X		X	X	X	X

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Name and define trade terms and definitions used in the welding trade		X	X	X	X	X	X	X	X	X	X
Study and compare the "master chart of welding processes"		X	X	X	X	X	X	X	X	X	X
Identify general safety rules for ARC welding		X	X			X		X	X	X	X
Use protective clothing, personal equipment, and proper eye protection		X	X	X	X	X	X	X	X	X	X
Wear and maintain a welding helmet in compliance with prescribed safety standards		X	X	X	X			X	X	X	X
Set up a welding station in preparation for welding		X	X	X	X			X	X	X	X
Demonstrate methods of striking the ARC		X	X			X		X	X	X	X
Identify types of welds and types of joints for ARC welding		X	X			X		X	X	X	X
Identify welding positions		X	X			X		X	X	X	X
Identify types of beads		X	X			X		X	X	X	X

LEHIGH COUNTY VOCATIONAL-TECHNICAL SCHOOL

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Welding

D. O. T. JOB CLASSIFICATIONS

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Identify direct current (D.C.) welding machines and set up a typical D.C. welding machine		X	X			X		X	X	X	X
Identify alternating current (A.C.) welding machines and set up a typical A.C. welding machines		X	X			X		X	X	X	X
Set up and operate engine driven generators		X	X			X		X	X		X
Identify accessories used for arc welding		X	X			X		X	X		X
Repair & maintain arc welding equipment & accessories		X				X		X	X		
Order welding supplies and materials required for daily operation of a welding shop		X		X	X	X	X	X	X		
Identify and classify electrodes used to weld steel		X	X					X	X		X
Identify and classify electrodes used to weld cast iron		X	X					X	X		X
Identify and classify electrodes used to weld stainless steel		X	X					X	X		X
Identify and classify electrodes used to do hard-surfacing operations		X	X					X	X		X

LEHIGH COUNTY VOCATIONAL-TECHNICAL SCHOOL
INSTRUCTIONAL TASK IDENTIFICATION

Welding

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Strike an arc and run short stringer beads		X	X					X	X	X	X
Clean a weld bead using a chipping hammer and wire brush		X	X					X	X	X	X
Restart an arc, make a continuous weld bead and fill the crater		X	X					X	X	X	X
Make weld beads using the "weaving motion"		X	X					X	X	X	X
Make weld beads using the "whipping" motion with E6010 and E6011 type electrodes		X	X					X	X	X	X
Build a weld metal pad (padding)		X	X					X	X	X	X
Recognize & analyze variables affecting the quality of weld beads		X	X					X	X	X	X
Weld a square-grooved butt joint		X	X					X	X	X	X
Weld a lap joint with a single-pass fillet weld		X	X					X	X	X	X
Weld a lap joint with a multiple-pass fillet weld		X	X					X	X	X	X

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INSTRUCTIONAL TASK IDENTIFICATION

WELDING

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Weld a tee joint with a single-pass fillet weld		X	X	X				X	X	X	X
Weld a tee joint with a multiple-pass fillet weld		X	X	X				X	X	X	X
Weld an open corner joint		X	X	X				X	X	X	X
Weld a single-vee butt joint with a backing strip		X	X	X				X	X	X	X
Weld a single-vee butt joint (groove weld) without a backing strip		X	X	X				X	X	X	X
Set up, weld, and test a groove weld test plate in accordance with AWS standards		X	X	X				X	X	X	X
Set up, weld, and test a fillet weld test plate in accordance with AWS standards		X	X	X				X	X	X	X
Make weld beads in the horizontal position		X	X	X				X	X	X	X
Make weld beads in the vertical-up position		X	X	X				X	X	X	X
Make weld beads in the overhead position		X	X	X				X	X	X	X

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Welding

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Identify general safety rules for MIG welding		X	X					X	X	X	X
Identify and set up air-cooled and water-cooled MIG guns, cables, and components		X	X					X	X	X	X
Identify and set up regulators, inert gas hoses, and adjust flowmeters		X	X					X	X	X	X
Identify and set up power sources (welding machines) used for the GMAW process		X	X					X	X	X	X
Identify and select filler metals		X	X					X	X	X	X
Identify and select proper shielding gases		X	X					X	X	X	X
Identify and set up wire feeders		X	X					X	X	X	X
Set up and adjust welding machine, wire feeder, MIG gun filler metal, and shielding gas in preparation for welding aluminum		X	X					X	X	X	X
Set up and adjust a welding machine, wire feeder, MIG gun, filler metal, and shielding gas for welding stainless steel		X	X					X	X	X	X
Replace an empty spool of filler wire on a wire feeder		X	X					X	X	X	X

LEHIGH COUNTY VOCATIONAL-TECHNICAL SCHOOL

INSTRUCTIONAL TASK IDENTIFICATION

WELDING

D. O. T. JOB CLASSIFICATIONS

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Analyze service requirements and service conditions for hardsurfacing		X						X	X	X	
Determine the composition and condition of the part to be hardfaced		X						X	X	X	
Follow recommended welding procedures for hardfacing		X						X	X	X	X
Identify and select hardsurfacing electrodes		X						X	X	X	X
Build up a surface using hardsurfacing electrodes		X						X	X	X	X
Know & demonstrate recommended equipment set-up procedures		X						X	X	X	
Identify safety hazards & comply with safety procedures		X	X	X	X	X	X	X	X	X	X
Recognize and determine the application of GMAW process		X						X	X	X	X
Know the fundamentals of the "Short Circuiting Metal Transfer Process"		X						X	X	X	X
Know the fundamentals of the "Spray ARC method"		X						X	X	X	X

LEHIGH COUNTY VOCATIONAL-TECHNICAL SCHOOL

INSTRUCTIONAL TASK IDENTIFICATION

WELDING

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ıow principles for welding transmission line pipe welding		X	X					X	X	X	X
" ıow principles for welding industrial pipe welding		X	X					X	X	X	X
Make weld beads on pipe using electrode types		X	X					X	X		
Weld a pipe joint in the rolled position		X	X	X				X	X		
' ld a pipe joint in the vertical tube position		X	X	X				X	X		
' ld a pipe joint in the horizontal-fixed position		X	X	X				X	X		
Weld a pipe joint in the 45 degree inclined position		X	X	X				X	X		
set up, weld, and test a welded pipe joint in accordance with AWS standards		X	X	X				X	X		
F llow recommended specifications for set up procedures		X	X	X				X	X	X	X
D termine proper joint fit-up for welding practices		X	X	X				X	X	X	X

LEHIGH COUNTY VOCATIONAL-TECHNICAL SCHOOL

INSTRUCTIONAL TASK IDENTIFICATION

Welding

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Make straight line cuts using a shielded metal-arc electrode		X				X					
Pierce holes in steel plate using a shielded metal arc electrode		X				X					
Know and demonstrate recommended equipment set-up procedures for ARC-AIR cutting		X				X					
Identify safety hazards & comply with safety precautions		X				X					
Set-up the are-air cutting torch, welding machine and compressed air line		X				X					
Make gouges in steel plate using the ARC-AIR torch		X				X					
Cut non-ferrous metals using the ARC-AIR torch		X				X					
Remove a weld by gouging using an ARC-AIR torch		X				X					
Set-up and adjust a welding machine and accessories in preparation for welding aluminum		X						X	X	X	X
Establish an arc and run weld beads on aluminum; with & without a remote foot control; with & without the use of filler metal		X						X	X	X	X

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WELDING

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Know and demonstrate the use & application of back-up bars		X	X					X	X		X
Determine amperage settings & make weld beads on sheet metal		X	X					X	X		X
Make welds on sheet metal joints		X	X	X				X	X		X
Identify types of cast iron		X	X	X				X	X		X
Prepare a broken casting for welding		X	X	X				X	X		X
Identify and select electrodes for welding cast iron		X	X					X	X		X
Weld, repair a broken casting		X	X		X			X	X		X
Identify and categorize types of stainless steels		X	X					X	X		X
Identify and select electrodes for welding stainless steel		X	X					X	X		X
Clean and prepare stainless steel for welding		X	X					X	X		X

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Replace an empty compressed gas cylinder		X	X	X	X			X	X	X	X
Recognize & determine the application of flux-cored arc welding		X	X					X	X	X	X
Identify and set up power sources used for the FCAW process		X	X					X	X	X	X
Set up and adjust a welding machine, wire feeder, welding gun, filler metal, and shielding gas in preparation for welding mild steel using FCAW process		X	X					X	X	X	X
Know and follow safety precautions when using hand tools		X	X					X	X	X	X

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Identify common hand tools and their uses		X	X	X	X	X	X	X	X	X	X
Inspect and repair hand tools		X	X					X	X		X
Operate electric hand drills		X	X					X	X		X
Operate a drill press		X	X					X	X		X
Sharpen drill bits		X	X					X	X		X
Perform maintenance on a drill press		X	X					X	X		X
Operate a pedastal grinder and wire wheel		X	X					X	X		X
Perform maintenance on a pedastal grinder		X	X					X	X		X
Operate portable disc grinders/sanders		X	X					X	X		X
Perform repairs on grinders/sanders		X	X					X	X		X

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Operate a horizontal and vertical band saw		X	X					X	X		X
Perform maintenance on a band saw		X	X					X	X		X
Operate a power cut-off wheel		X	X					X	X		X
Perform maintenance on a cut-off wheel		X	X					X	X		X
Operate a hydraulic power shear		X	X					X	X		X
Perform maintenance on a power shear		X	X					X	X		X
Operate a hydraulic iron worker		X	X					X	X		X
Perform maintenance on an iron worker		X	X					X	X		X
Scrape and paint machines		X	X					X	X		X
Estimate cost of repairs		X							X		

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Inspect work area for safe working environment		X	X	X	X	X	X	X	X	X	X
Describe submerged ARC welding		X						X	X	X	
Describe electroslag and electrogas welding		X						X	X	X	
Describe stud welding		X						X	X	X	
Describe ARC spot welding		X						X	X	X	
Describe atomic hydrogen welding		X						X	X	X	
Describe plasma ARC welding		X						X	X	X	
Describe thermit welding		X						X	X	X	
Describe forge welding		X						X	X	X	
Describe cold welding		X						X	X	X	

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Describe ultrasonic welding		X						X	X		
Describe electron beam welding		X						X	X		
Describe friction welding		X						X	X		
Describe explosive welding		X						X	X		
Describe laser welding		X				X	X				
Describe oxygen lance cutting principles, equipment and procedures						X	X				
Describe oxygen-fuel gas underwater cutting principles, equipment and procedures						X	X				
Describe oxygen--underwater cutting principles, equipment, and procedures						X	X				
Describe powder cutting principles, equipment, and procedures						X	X				
Describe plasma-arc cutting (PAC) principles, equipment, and procedures								X	X		

LEHIGH COUNTY VOCATIONAL-TECHNICAL SCHOOL
INSTRUCTIONAL TASK IDENTIFICATION

Welding

TASKS	V-TECS TASK NOS.	D. O. T. JOB CLASSIFICATIONS 1	2	3	4	5	6	7	8	9	10
		810.384-014 Welder, ARC	810.684-010 Welder, Tack	811.684-014 Welder, Gas	813.684-010 Brazer, Assembler	816.364-010 ARC Cutter	816.464-010 Thermal Cutter, Hand I	819.361-014 Welder-Fitter Apprentice	819.384-010 Welder, Combination	819.684-010 Welder, Production line	819.687-014 Welder Helper
Describe and define "Visual Inspection"		X						X	X		
Describe and define "Magnetic Particle' Inspection"		X						X	X		
Describe and define "Liquid Penentrant Inspection"		X						X	X		
Describe and define "Ultrasonic Inspection"		X						X	X		
Describe and define "X-Ray Inspection"		X						X	X		
Describe and define "Eddy-Current Inspection		X						X	X		
Describe and define Bend Tests		X						X	X		
Describe and define Impact Tests		X						X	X		
Describe and define Tensile Test		X						X	X		
Describe and define the Microscopic Test		X						X	X		

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D. O. T. JOB CLASSIFICATIONS

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escribe and define the Macroscipic Test		X						X	X		
scribe and define the Hardness Testing		X						X	X		
fine and define Chemical Analysis Testing		X						X	X		
ame associations, societies, & governmental agencies esponsible for establishing codes and standards		X						X	X		
ame organizations responsible for establishing stan-ards for welding equipment		X						X	X		
ame and differentiate procedure qualifications and perator qualifications		X						X	X		
eview the American Welding Society "Structural Steel elding Code"		X						X	X		
tudy the history of steel manufacturing		X	X	X	X			X	X	X	X
tudy the operation of the open hearth furnace		X	X	X	X			X	X	X	X
udy the operation of the Bessemer converter		X	X	X	X			X	X	X	X

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Study the operation of the electric furnace		X	X	X	X			X	X	X	X
Study the operation of the vacuum furnace		X	X	X	X			X	X	X	X
Describe casting		X	X	X	X			X	X	X	X
Describe hot and cold rolling		X	X	X	X			X	X	X	X
Describe forging		X	X	X	X			X	X	X	X
Describe extruding		X	X	X	X			X	X	X	X
Describe drawing		X	X	X	X			X	X	X	X
Study and identify physical properties of iron & steel		X	X	X	X			X	X	X	X
Study and identify alloy metals		X	X	X	X			X	X	X	X
Study and analyze spark tests		X	X	X	X			X	X	X	X

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Study and analyze torch tests		X	X	X	X			X	X	X	X
Study and analyze chemical tests		X	X	X	X			X	X	X	X
Identify the S.A.E. numbering systems for metals		X	X	X	X			X	X	X	X
Define nonferrous metals		X	X	X	X			X	X	X	X
Compare and identify copper		X	X	X	X			X	X	X	X
Compare and identify brass		X	X	X	X			X	X	X	X
Compare and identify bronze		X	X	X	X			X	X	X	X
Compare and identify aluminum		X	X	X	X			X	X	X	X
Compare and identify hard surfacing metals		X	X	X	X			X	X	X	X
Compare and identify other elements		X	X	X	X			X	X	X	X

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		1	2	3	4	5	6	7	8	9	10
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Name the purpose of heat treatment								X	X		
Name the methods of heat treatment								X	X		
Name the methods of cooling								X	X		
Identify the various carbon contents of steel								X	X		
Identify the crystalline structure of steel								X	X		
Describe annealing of steel								X	X		
Describe hardening of steel								X	X		
Describe tempering (drawing) of steel								X	X		
Describe casehardening								X	X		
Name terperature measuring								X	X		

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Heat treat various metals								X	X		
Add whole numbers								X	X		
Subtract whole numbers		X	X	X	X	X	X	X	X	X	X
Multiply whole numbers		X	X	X	X	X	X	X	X	X	X
Divide whole numbers		X	X	X	X	X	X	X	X	X	X
Interpret common fractions		X	X	X	X	X	X	X	X	X	X
Identify fractional divisions of the steel tape		X	X	X	X	X	X	X	X	X	X
Add common fractions		X	X	X	X	X	X	X	X	X	X
Subtract common Fractions		X	X	X	X	X	X	X	X	X	X
Multiply common fractions		X	X	X	X	X	X	X	X	X	X

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Welding

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Divide common fractions		X	X	X	X	X	X	X	X	X	X
Interpret decimal fractions		X	X	X	X	X	X	X	X	X	X
Add and subtract decimal fractions		X	X	X	X	X	X	X	X	X	X
Multiply a decimal fraction		X	X	X	X	X	X	X	X	X	X
Divide decimal fractions		X	X	X	X	X	X	X	X	X	X
Round off decimal fractions		X	X	X	X	X	X	X	X	X	X
Change fractions and decimals		X	X	X	X	X	X	X	X	X	X
Convert linear measure into larger and smaller units		X	X	X	X	X	X	X	X	X	X
Add and subtract units of linear measure		X	X	X	X	X	X	X	X	X	X
Multiply and divide units of linear measure		X	X	X	X	X	X	X	X	X	X

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Use the metric system		X	X	X	X	X	X	X	X	X	X
Identify english-metric equivalents		X	X	X	X	X	X	X	X	X	X
Compute perimeters of rectangles		X	X	X	X	X	X	X	X	X	X
Compute perimeters of circles and semicircular sided figures		X	X	X	X	X	X	X	X	X	X
Identify units of angular measure		X	X	X	X	X	X	X	X	X	X
Use the protractor		X	X	X	X	X	X	X	X	X	X
Compute areas of squares and rectangles		X	X	X	X	X	X	X	X	X	X
Compute areas of triangles and trapezoids		X	X	X	X	X	X	X	X	X	X
Compute areas of circular figures		X	X	X	X	X	X	X	X	X	X
Compute volumes of cubes and rectangle solids		X	X	X	X	X	X	X	X	X	X

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Compute volumes of cylindrical solids		X	X	X	X	X	X	X	X	X	X
Compute capacities of rectangular structures		X	X	X	X	X	X	X	X	X	X
Compute capacities of cylindrical and complex structures		X	X	X	X	X	X	X	X	X	X
Compute weights of steel structures		X	X	X	X	X	X	X	X	X	X
Compute averages		X	X	X	X	X	X	X	X	X	X
Compute percentages		X	X	X	X	X	X	X	X	X	X
Estimate strecthouts of square and rectangular shapes		X	X	X	X	X	X	X	X	X	X
Estimate strecthouts of circular and semicircular shapes		X	X	X	X	X	X	X	X	X	X
Estimate economical layouts of rectangular plates for welding		X	X	X	X	X	X	X	X	X	X
Estimate economical layouts of odd-shaped plates		X	X	X	X	X	X	X	X	X	X

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Determine salary and hours		X	X	X	X	X	X	X	X	X	X
Compute overtime salary		X	X	X	X	X	X	X	X	X	X
Compute piecework rates		X	X	X	X	X	X	X	X	X	X
Comput yearly wages with benefits		X	X	X	X	X	X	X	X	X	X
Compute take home pay		X	X	X	X	X	X	X	X	X	X
Assign work to others		X	X	X	X	X	X	X	X	X	X
Plan and schedule work assignments		X	X	X	X	X	X	X	X	X	X
Assign custodial tasks, sweep, and clean shop facility		X	X	X	X	X	X	X	X	X	X
Clean and maintain work and adjacent work areas		X	X	X	X	X	X	X	X	X	X
Supervise machine use and operation		X	X	X	X	X	X	X	X	X	X

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Review and research technical publications and journals for welding standards and the latest welding technology		X	X	X	X	X	X	X	X	X	X
								X	X	X	X
Estimate and prepare an annual shop budget								X	X	X	X
Understand and determine and application of TIG welding								X	X	X	X
Identify general safety rules for TIG welding								X	X	X	X
Use protective clothing, personal equipment, and proper eye protection								X	X	X	X
Wear and maintain a welding helmet in compliance with prescribed safety standards								X	X	X	X
Identify and set up air-cooled and water-cooled TIG torches, cables, and components								X	X	X	X
Identify and set up regulators, inert gas hoses and adjust flometers								X	X	X	X
Identify and set up power sourced (welding machines) used for the GTAW process								X	X	X	X

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Supervise maintenance of shop safety equipment, safe operations, and set up of machinery		X		X		X	X	X	X		
Dispose of scrap metal, chips or shavings, and trash of waste material		X	X			X	X	X	X		X
Write performance standards for job								X	X	X	
Conduct oral safety briefings								X	X	X	
Prepare accident reports								X	X	X	
Follow-up on end product quality control standards								X	X	X	
Inventory supplies and material								X	X	X	
Determine availability of supplies and materials, maintain files, order and receive new shipment of supplies.								X	X	X	
Estimate labor and material costs of new fabrications								X	X	X	

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Identify and select proper shielding gases								X	X	X	X
Identify and classify types of tungsten electrodes in accordance with AWS standards								X	X	X	X
Recognize and compare the characteristics of welding aluminum								X	X	X	X
Identify and name the various aluminum alloys								X	X	X	X
Clean and prepare aluminum for welding.								X	X	X	X
Recognize and analyze variables affecting the quality of welds made in aluminum								X	X	X	X
Change an emtpy shielding gas cylinder								X	X	X	X
Know and demonstrare the use and application of back-up bars								X	X	X	X